THE

ELECTRICAL REVIEW.

VOL. XXXII. MARCH 31, 1893. No. 801

CONTENTS:

	PAGE
St. Louis National Electric Light Association	361
State Supervision of Medical Practitioners	363
Specifications, Advertisements and Tenders	363
The Applications of Ozone (*continued*) (*illustrated*)	364
The Telephone in Vienna	366
A Photographers' Electric Pencil (*illustrated*)	367
An Induction Coil for Alternating Currents (*illustrated*) ...	367
A Novel Indicator Gear (*illustrated*)	369
Electric Light and Gas	369
Economy of a Non-condensing Compound Engine (*illustrated*) ...	370
Variable Speed Power Transmission (*illustrated*)	371
The Elmore Collapse	372
Notes	374
Contracts Open and Closed	378
Business Notices, &c.	378
City Notes, &c.:—Notting Hill Electric Lighting Company ...	379
Direct Spanish Telegraph Company	380
Arcas Plating Company	380
Chatham, Rochester and District Electric Lighting Co. ...	380
Traffic Receipts	380
Share List of Electrical Companies	381
Thermal Storage for Central Stations	382
The Alternating Current System in America	382
Comparative Tests of Hellesen and E.C.C. Dry Battery Cells (*illustrated*)	384
Legal:—Telegraph Construction and Maintenance Company *v.* Western and Brazilian Telegraph Company	387
New Patents	387
Abstracts of Published Specifications	388

J. A. BERLY'S

UNIVERSAL ELECTRICAL DIRECTORY

For 1893

IS NOW READY.

PRICE 4/- POST FREE.
The **Leading Electrical Trades Directory** *and the Oldest Electrical Directory in the World.*

ORDER AT ONCE

PRICE 4/- POST FREE.
Fully Revised and Thoroughly Reliable.
Contains a larger amount of commercial Trade Matter than any other Electrical Directory.

H. ALABASTER, GATEHOUSE & CO.,
22, Paternoster Row, London, E.C.
(*See Notice on Advertisement Page* 15.)

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—22, PATERNOSTER ROW, LONDON.

Telegraphic Address "AGEKKAY, LONDON." Code A B C. Telephone No. 517

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades.

SUBSCRIPTION RATES.—In *Great Britain*, Post Free, per Year, 19s. 6d. To all *Foreign Countries* (except those mentioned below), per Year, £1 1s. 8d. *Exceptions.*—Abyssinia, Aden, Borneo, Ceylon, India, Java, Labuan, Mozambique, Penang, Persia (*viâ* Brindisi), Phillipine Islands, Singapore, Zanzibar, to which the rates are: per Year, £1 3s. 10d.

BINDING.—Subscribers' numbers bound, including case, for 3s. 6d. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each.

READING CASES, to hold from One to Twenty-six Numbers until the Volume is complete for Binding, can now be had from the Publishers, Price 6s., or Free by Post (in Great Britain), 6s. 6d.

FOREIGN AGENTS.—*New York:* D. VAN NOSTRAND, 23, Murray Street. *Paris:* VEUVE J. BOYVEAU, 22, Rue de la Banque. *Berlin:* ASHER & Co., 5, Unter den Linden.

Cheques and Postal Orders (on Chief Office, London) to be made payable to Mr. H. ALABASTER, 22, Paternoster Row E.C.

ST. LOUIS NATIONAL ELECTRIC LIGHT ASSOCIATION.

THIS convention was one of the best attended of recent years, and among the most attractive features was the lecture by Mr. Nikola Tesla at the Exposition Hall, which has a seating capacity of 5,000 people, and which was overflowed with the most brilliant assemblage St. Louis has ever witnessed. On the platform sat President Ayer, Prof. George Forbes, and several prominent American electrical engineers. Mr. Tesla showed the interesting effects produced by currents of high frequency, already well known to those who had the privilege of attending Mr. Tesla's lectures in London and Paris.

Some of the topics discussed at these conventions run in grooves, that is to say, some theme or another receives an unusually large share of attention. During the earlier period of the Association's existence, electric lighting was the principal subject; indeed, the Society adopted the title "National Electric Light Association." More recently, papers on electric railways almost monopolised the atmosphere of the meetings. This year no fewer than three papers were read relating to the electric transmission of power, and a few remarkable statements dropped from the mouths of speakers, some of which we shall quote.

Mr. Charles S. Bradley devoted himself to a short paper on "Long Distance Transmission of Power," in which he criticises the Lauffen-Frankfort experiments, and he endeavours to show that alternating currents as at present understood offer a series of difficulties, and he actually comes to the conclusion that "on very long lines the transmission must be done by direct current." The Lauffen-Frankfort plant, he contends, was built with much sacrifice of time and money. This plant proved conclusively that very high voltages could be successfully used, and the insulation maintained. Surprising as it may seem, the maintenance of the insulation was the least trouble. The important difficulty is the static induction; each wire, being so long and exposing so much surface, becomes a reservoir to hold electricity, and the generator must fill this reservoir on each impulse before it can deliver energy at the distant end. When the generator reverses the direction of current, as it does some 100 times per second in alternating, this reservoir must be discharged and filled with electricity of opposite sign. This operation consumes but little power; it is an ebb and flow, as it were. The trouble, however, is that this idle current in swinging to and fro occupies the carrying capacity of the generating apparatus; so much so, that Mr. Bradley saw the fuses blown at Lauffen when no load of consequence was at the Frankfort end. In damp weather the insulators hold water on the external surfaces, and this largely increases the capacity, which is more serious than increased leakage. The carrying capacity is proportional to the square of the diameter of the

transmission wire, while the static capacity is proportional to the surface, which is equivalent to being proportional to the diameter. The Lauffen-Frankfort was an extreme case. First, the line was much longer than we shall expect to use for some time to come in practical work; second, the plant was intended for 300 H.P., and a rate of 40 phases per second. Owing to the static effects at 40, the rate had to be lowered to about 23 per second; accordingly the dynamo had to run at a reduced speed, so that it only produced about 100 H.P. Mr. Bradley admits that the multiphase is the most pliable adjustable system that has ever been conceived. It fairly entwines itself about the electrical engineer's heart. It is capable of transformation in voltage, will supply motors of either the synchronous or non-synchronous type, and will readily convert in motor transformers to direct current distribution, and thus supply direct current motors. A patent was issued to Mr. Bradley in October, 1888, which covers this ground. At the factory of the Fort Wayne Electric Company, Mr. Bradley had exceptional facilities for experimenting on the multiphase systems, some 270 different tests having been made on motors, dynamos, and transformers, the record of which fills a respectable volume. If this could be given to the world, that engineers might know what *not* to do, undoubtedly the wings of many a genius would be clipped. Where the power is to be delivered in compact form the direct current offers some important advantages, says Mr. Bradley, and he suggests continuous current shunt-wound machines of not more than 500 volts each.

For the generator station he prefers compound wound machines, in order that the system may be self-regulating, and that the series coil, when the machine is thrown into action, shall magnetise the field in the right direction. In this case the switch must close the series coil first. The shunt coil would tend to reverse until the machine has attained electromotive force enough to overcome the resistance of its own armature. In order that each machine shall be independent of its neighbours, Mr. Bradley prefers that it shall be short-shunt, or, in other words, the shunt coil be charged direct from the brushes of each machine. The 500 volts have been found safe to life, and the commutator works well. Now, we must protect the insulation of the windings; the end machine, where the terminal voltage reaches, say, 20,000 volts, may, in case of earth, be subjected to the piercing strain of the entire electrical pressure. It is impracticable to insulate the windings of each machine to stand any such potential, therefore we connect the windings of the machine at some point with the frame, so that it may never be subjected to a strain greater than its own voltage. Next, each machine foundation is thoroughly insulated from earth, and in case this insulation fails for any reason, the fuses of the line will be blown, thus protecting the whole structure. It is easy, however, to make this foundation insulation so perfect that no derangement will take place. Having now provided for the insulation, Mr. Bradley next considers the safe handling of the machines. A moment's consideration of the electrical potential of each successive machine in the series will make it evident that the whole of each machine will obtain the potential of its individual position; or, beginning at one end, each successive machine will be 500 volts above the preceding one.

It is essential, as already pointed out, that the windings be in metallic connection with the frame for the safety of human life. This secures that no part of a machine can exceed its own voltage, and in case of a leakage in the foundation insulation it is immediately detected. At the motor station we use simply 500-volt shunt machines, with the same precautions as at the generator station. If it is in an electric system of distribution, we have the advantage of its being impossible for the high-tension current to get into the system of distribution.

Dr. Louis Bell presented a paper on "Power Transmission for Central Stations," in which he condemns the European experiments as not reliable, of no practical value, and having been clumsily conducted. He maintains that direct-current machines cannot be satisfactorily built for more than about 1,200 volts, except for very small power units as in arc lighting machines, where higher voltages are common. For excessive voltages we are driven to the use of either continuous current machines put in series, or alternators. Dr. Bell points out that it is highly desirable for the successful operation of continuous current motors in series, that they should be practically coupled to the same shaft, and should run under similar and uniform conditions. So while there are cases in which the method of coupling in series may be both convenient and cheap, yet it is in his opinion better to employ alternating currents after passing the ordinary limitations of continuous currents. Here we encounter a complicated state of affairs; for the central station man who attempts to investigate the subject is immediately surrounded by a cloud of mental dust, through which he sees dimly the outlines of plain alternators, bi-phase, tri-phase, and multiphase generators and motors, condensers, Geissler tubes, six foot fuses, electrified wall paper, and the other properties of a well-equipped modern high-voltage electrician. We want to use alternating currents for two good and separate reasons, first because we get rid of the commutator, and can therefore use as high voltages as we can safely insulate in the machine; second, because by the use of transformers we can obtain for the transmission line itself any voltage which we can insulate, and thereby enormously decrease the cost of the copper which must be stowed away as a permanent investment in our line.

Multiphase currents are subject to the same general laws as any other alternating currents. Their most valuable peculiarity, says Dr. Bell, lies in the fact that for alternating currents of more than one phase excellent motors can be built, which will run at a steady speed, start under heavy load, and, in general, possess very much the same qualities as a well-designed shunt motor of the ordinary kind. The three-phase system also enjoys the advantage of effecting a saving in copper under favourable circumstanees up to 25 per cent. from what would be required by an ordinary alternating system of the same voltage. He points out all the advantages of the multiphase system, even to the distribution of light incandescent lighting, although we do not know of a single instance in the United States where the system has been employed on a commercial scale. We can only conclude that he can only draw his inferences from what has been accomplished in Europe, notwithstanding his sarcastic remarks. He adds that there is a possibility that we may have before long practicable motors to run on an ordinary alternating circuit, constructed as suggested by Prof. Elihu Thomson a few years ago. Mr. C. E. L. Brown, abroad, has been making a desperate effort, says Dr. Bell, to exploit these

new methods on his own responsibility, and has obtained motors which run successfully, but, as yet, do not start well under load. In connection, we would point out that we have recently seen a number of alternating motors constructed by Mr. C. E. L. Brown, of one-quarter to 20 H.P. capacity, driving machinery, workshops, saw-mills, lifts, &c., with perfect success, and we have had the opportunity of testing the self-starting qualities of some of these motors. Here, again, Europe is ahead of America in the practical application of a useful invention.

The third paper, entitled, "Remarks Concerning Power Transmission from the Economic Stand-Point," was presented by Mr. L. B. Stillwell. This relates mostly to formulæ, and a new nomenclature, which he suggests might be adopted for calculations of power transmission.

We need not refer at length to this communication except that the author ventures a remark to the effect that very few men even among those who are actually operating central stations are able to say exactly what the power costs them, and that it is not surprising that the engineer who is called upon to lay out, let us say, an elaborate plan for the utilisation of water-power, finds it difficult to give explicit answers to questions relating to the cost of operating such a plant, probable revenue to be derived from the sale of power and in general economic feasibility. We trust that this remark applies only to his side of the Atlantic.

The discussion which followed these papers elicited but few important remarks.

STATE SUPERVISION OF MEDICAL PRACTITIONERS.

Our call for state protection against bogus practitioners in all branches of the medical profession, is making itself heard in the right quarter, and we have now but little doubt that some reforms will soon be realised. In a recent pamphlet, published by Messrs. Ballière, Tindall & Cox, there is a statement by Mr. Henry Sewill of the written and unwritten laws which have been made with regard to unqualified practitioners, chiefly in reference to dentists, but very generally applicable throughout the profession. Nominally the legislature protects the public against quacks and adventurers—but only nominally—by the provision of duly qualified men, through the agency of the College of Surgeons and allied institutions. The legislature, on the other hand, has omitted, up to the present, to make sufficient provision for the enforcement of laws devised by them for the express purpose of discouraging the malpractices of the charlatans. If a registered practitioner offends against the law of his profession, he is promptly called to order by the General Medical Council. The General Medical Council, however, takes no cognizance of the misdemeanours of unqualified pretenders, but leaves their vindication to private enterprise. It will thus be seen that the State has brought into existence an elaborate scheme for the dispensation of the best possible medical and surgical aid to the public, but has yet before it the distasteful task of cleansing the stables of bogus practitioners. The state has "added the wings," but she has forgotten to "remove the weights," but one is as necessary, to the advantaging of motion, as the other. Mr. Sewill shows the importance of help in this regard, and he makes out a very strong case in a very few words, by proving that quackery forms a serious and potent factor in the deterioration of the public health, instancing the many cases of serious disease which are the evident outcome of a simple ailment aggravated by the brutal vendors of nostrums and panaceas. As a practical suggestion Mr. Sewill urges that the General Council should take upon themselves the enforcement of the medical law. With this duty added to its present functions, its control over the medical profession would be complete. The eminence of the individual members of the Council — assured by its constitution—must always be a guarantee of its judicial capacity, and it is certain the Council would ever exercise its powers to the true interests of the public.

SPECIFICATIONS, ADVERTISEMENTS AND TENDERS.

Since the adoption of electric lighting by so many corporations and public bodies, considerable numbers of arc lamps, dynamos and other appliances are frequently advertised for, apparently with a view to open healthy competition for the contract. We say apparently for that purpose, advisedly, for in nearly every specification recently issued to contractors, manufacturers, &c., it is found that the lamp, dynamo, or other appliances to be supplied to meet the specification, is specified by the name of the makers of them. Where, then, is the competition in such a case? The maker specified gets the order at his own price, and a very good gratuitous advertisement thrown in.

The advertisement calling for contractors to tender usually contains a stipulation that £1 1s. or £2 2s. and sometimes £5 5s. must be lodged before any specification can be obtained at all, and this same advertisement is usually written so that everyone would imagine that the competition for the work to be done would be perfectly open to every reputable manufacturer; only after he has paid his guineas in deposit does he find that the specification is nothing more than an order for so many of somebody's lamps or dynamos, which is all prepared and ready to be placed with that somebody or his agents.

It seems an injustice to demand a deposit from a manufacturer, and then effectually prevent him from tendering his own lamp, dynamo, or engine, and it seems not far from adding insult to injury when he is compelled to estimate for his rivals' plant in a *bonâ fide* tender or lose his deposit.

If a certain lamp or appliance is specified, why not state so in the advertisement, and thus save those who cannot or will not supply such an apparatus or appliance the expense and trouble connected with applying for specifications, lodging deposits, and sending in a tender, a tender which is most likely sent in merely to recover his deposit.

If competition for the supply of plant is not to be perfectly open and the specification states that the plant must be made by either Messrs. Jenkins, Jones or Smith, why not simply send specifications to Jenkins, Jones and Smith and let the three compete for the contract, in any case one of them must get the order for the plant.

We cannot, and do not, find fault with an engineer or corporation determining to have a certain firm's manufactures in preference to all others; the fault lies in not making it clear in the advertisement that only these manufactures are wanted.

THE APPLICATIONS OF OZONE.

[FROM A CORRESPONDENT.]

(*Concluded from page* 338.)

SCHNELLER AND WISSE, 1891.

The Schneller and Wisse ozoniser is a condenser consisting of conductors enclosed within a glass tube. A number of such tubes, each enclosing a metallic rod or wire, is arranged in rows in such a manner that each of their conductors shall be located at an equal distance from the conductors immediately above. Each row of tubes is connected with one of the poles of an alternating current dynamo or transformer.

Is it not rather curious to see that the old Babo apparatus, which was never the object of any application for protection and monopoly under Royal Letters Patent, has been revivified more than 40 years later and patented by Messrs. Schneller and Wisse who declare that *they are aware it has been proposed to produce ozone, to this they make no claim*, but, *they claim*, the apparatus which I have just described, the *blower* to pass the air through a *filter*, through a *chamber* or *chambers* containing *dessicating* materials ?

I fancy the combination of the blower with the filter and the dessicating chamber has been known since 30 years at least, as well as the use of a coil and therefore of a high tension and frequency apparatus.

Does the electric discharge, which acts upon the oxygen flowing through the generator, pass through the solid glass rods and the thick glass plates ? Fahrig answers the question in the affirmative. According to him, an inspection of the box during action, reveals a *bluish brush discharge between* plates and tubes ; and as the gas fed to the boxes is oxygen, and that leaving the box is ozone, and as the electrical discharge through oxygen produces ozone, it must be very reasonable to conclude that the brush discharge must be through the glass. This has been well known, many years ago, and I will not discuss the point, but I cannot endorse his theory that " it is a mistaken idea that ozone can be produced at *any per cent.* of strength, that 6 to 7 per cent. is about the strongest one would care to handle, and that 1 per cent. of ozone is strong enough for any commercial oxidation."

There is very little difference between the Schneller and Fahrig apparatus ; the condenser of the former is made of *rows of glass* tubes, enclosing a conducting wire or rod in such a manner that *each row of conductors is alternately connected* with one pole of a coil or transformer ; the Fahrig condenser is made of *flat aluminium sheets, imprisoned between two glass sheets*, and *disposed between rows of glass tubes containing each a metallic rod.*

Fahrig, in 1886 or 1887, had tried the treatment of sugar by ozone, and he employed a network or sieves of platinum to which a high tension current was transmitted. Raw sugar was placed between non-conducting plates of perforated china or porous biscuit, and submitted to the influence of large electric sparks ; he soon abandoned this process.

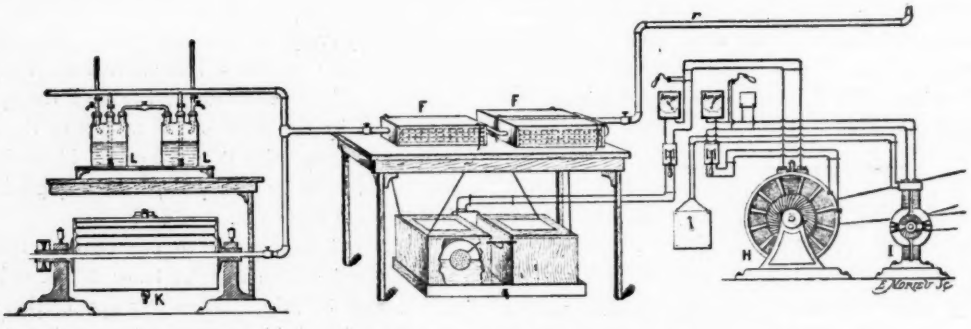


FIG. 22.—FAHRIG INSTALLATION AT MARSEILLES, U.S.A., FOR THE PRODUCTION OF OZONE.

I, Exciter dynamo ; N, Alternating dynamo, 112 ampères and 50 volts ; under the table are two transformers working at a calculated electromotive force of 40,000 volts. I need not describe the wires, resistance, ammeter, voltmeter, and switches ; F, F, three ozone generators through which oxygen passes, is ozonised and sent to two experimental jars, L L, for the purpose of treating various liquors, and also to an apparatus for ozonising alcohol.

INTERNAL ARRANGEMENT OF THE OZONE GENERATOR.—The case or box is made of wood 24 × 18 × 8 inches, it is lined with glass, and air-tight.

FAHRIG AND SCHNELLER.

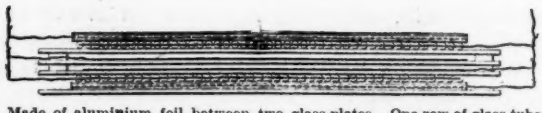
We are indebted to the *Western Electrician* (1892) for some particulars on the Fahrig electrostatic process for the manufacture of ozone, which is employed at Marseilles, U.S.A., in conjunction with the American Ozone Water Company, who utilise the gas to ozonise table water and high grade carbonated mineral water.

The two establishments are separate and the ozone is delivered by pipes to the Ozone Water Company.

The Fahrig ozone generator is made up of plates of ½ inch glass, and glass tubes ½ inch diameter.

The plates and the layers of tubes are arranged alternately.

Each tube is drawn solid at one end and contains aluminium wire.



Made of aluminium foil between two glass plates. One row of glass tubes. An aluminium foil plate protected by two glass sheets between two rows of glass tubes, and so on. The distance between the wires and the plates is 5 millimetres. The surface of the entire discharging medium is 10 by 20 inches.

FIG. 23.—FAHRIG CONDUCTOR.

Fahrig says that the generator, although very simple, requires the greatest care in constructing. The aluminium must be very pure ; the rods and plates are washed in nitric acid, rinsed, dipped in water, then in spirit, and are then coated with a varnish.

Then, in 1888, he adopted a form of ozoniser which does not resemble at all the one which is worked at present at Marseilles. This ozone generator consists of a number of plates corrugated, in order to increase their surface (it is rather difficult to understand how a plate, which is no longer parallel to the opposite plate, can have its effective surface increased by being corrugated) ; each plate was made of non-conducting material coated on one side with metal foil, and connected to one of the terminals of the secondary coils of an inductor, the next plate in order being connected to the other terminal.

The ideas of Fahrig on the application of ozone are worth knowing : " How numerous are the uses of ozone may be estimated by summing up the large number of industries that are dependent upon the oxidation or chemical change of one or other of the constituents or materials employed in the manufacture. To give them all would be to summarise the arts. The process of bleaching is an oxidising of the crude coloring matter, and it is of the utmost importance that this shall be done thoroughly and without injury to the fibres of the fabric. The drying of oils, varnishes and paints, and the rapid finishing of certain manufactures, which now take weeks, require the use of oxidisers. It has also sanitary and disinfecting application, its action being to oxidise or literally burn up organic matter, including the offensive and infectious germs."

It has been found that the Schneller and Wisse system is an improvement on the Fahrig and Billing process which I have just now described (corrugated plates) and the " Ozone Syndicate," who work this system, has a peculiar way of

describing the Schneller-Wisse condenser, as one can judge from the following, which shows that the *brush* discharge of electricity is produced by the dynamo and transformer of the *Brush* Electrical Engineering Company. This explains why they call the luminosity of the glow a brush, instead of a silent discharge. The combination of the apparatus employed consists of a *fan* or *blower* to circulate the air, a *filter* and *dessicator* to purify and dry the air, and an *ozoniser* in which the air is subjected to the brush discharge of electricity under the influence of an alternate current dynamo and a transformer, giving a difference of potential of 20 to 25,000 volts. The *principal feature of the invention* is the ozoniser, which *consists of quarter-inch glass tubes spaced about one inch apart.* Each tube has an aluminium wire inside it, which wires are connected alternately with the two terminals of the transformer.

"On starting the dynamo, the alternations (100 a second) are so rapid that the space between the glass tubes is filled with a blue brush discharge, and the air passing between the tubes is effectually electrified. In practice, the ozonisers are contained in a brick or slate chamber.

"The output of ozone is stated to be 240 grammes per H.P. hour.

"In Amsterdam the plant of the Continentale Ozone Company consists of a 25 kilowatt Mordey-Victoria alternator, several 8 kilowatt transformers, rising from 100 to 25,000 volts, and three ozonising chambers, each about 10 feet by 6 feet by 4 feet. Each chamber contains 16 ozonisers which absorb 8 kilowatts, so that the three chambers require in full work 24,000 kilowatts. The ozonised air is conducted away from the chambers by two earthenware tubes, 18 inches diameter."

So long as we have not the fullest details on the method adopted for the determination of ozone, we shall be entitled to remain sceptical about this yield of 8 kilogrammes of ozone per hour, that is, about 240 grammes per E.H.P. hour. "The determination of ozone is a most delicate one," said Schonbein, the discoverer of ozone. "As yet, we possess no chemical reaction, by means of which we can prove the existence of ozone in the air." But for Dr. Houzeau, the progress made in that direction would not be great, and before accepting as correct the yield of 240 grammes of ozone per E.H.P., we want to know the name of the chemist who is responsible for such an assertion, and if it is the Houzeau and Thenard, Berthelot, Mohr, or other method of determination, which was adopted for the titration of ozone, and under what conditions of temperature, of quantity of atmospheric air passing through the chambers, these results were obtained.

Andreoli, 1892-93.

Ozone is generated in larger quantities by means of point bearing electrodes than when the electrodes are flat surfaces on which the tension is weak and uniform. The electric tension is at its maximum when there are sharp points from which the discharge escapes in, so to speak, a continuous flow. The best form of electricity for the production of ozone, the silent discharge or glow as Faraday called it, is the effluvium as Hauksbree said, because the spark is disseminated with a relatively feeble increase of heat. The disruptive discharge is far less favourable to the production of ozone than the silent discharge, and when there is no glow there is no ozone. From the experiments by Berthelot, Bichat, Gunz, and others, it results that the formation of ozone depends especially on the rise of the temperature of oxygen under the influence of the electric sparks.

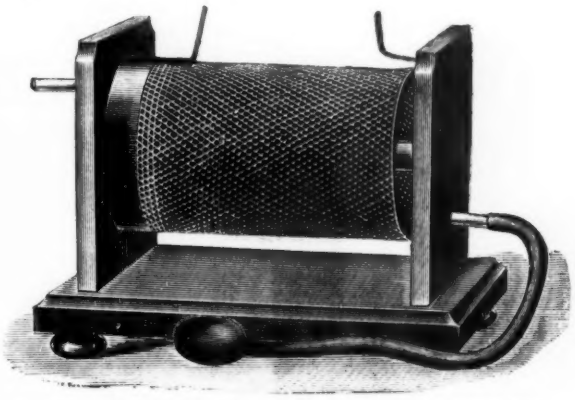
The older forms of ozonisers are generally tubular, air, or rather oxygen, being sent through a passage of minute dimensions between two concentric glass tubes; such tubes fitted with electrodes are necessarily costly and required to be employed in considerable numbers, in order to produce any sufficient supply of ozone.

The construction of the Andreoli ozoniser is based on the well-known tendency of electricity to flow off a point, and the characteristic feature of his apparatus is that the electrodes (one or both) bear numerous points. The advantage thus gained is that the apparatus will work in the air of any apartment. The ozone, as formed, diffusing through the room without any tube or other enclosure, or any mechanical means for producing a draught. These point-bearing electrodes are applicable to small apparatus, capable of being worked by primary or secondary batteries with induction coils, in ordinary apartments and are equally suited to large installations worked by dynamos and transformers for hygienic ventilation or commercial applications.

The following cuts represent some forms of small apparatus for hygienic purposes.

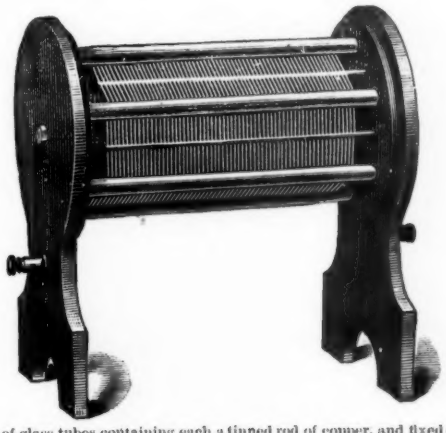
Small ozoniser consisting of a plate bearing points on both sides, which is placed between two electrodes each formed of a plain enamelled metallic plate, rendering unnecessary the usual intervening sheets of glass, mica, or other dielectric, the construction of the apparatus being thus much simplified.

Fig. 24.—Andreoli Point-Bearing Ozoniser.



Ozoniser receiving the air from any suitable pump. This instrument shows a perforated metal armature fixed on a glass cylinder which contains a porcupine cylinder, *i.e.*, a double-pointed cylinder, one of the sides of which faces the outer armature, and the other a central glass cylinder filled with a metallic core.

Fig. 25.—Andreoli Ozoniser with Air Injector.



Made of glass tubes containing each a tinned rod of copper, and fixed opposite the teeth of double combs, on which the electric silent discharge takes place, producing a luminosity with formation of ozone which diffuses itself and freely circulates.

Fig. 26.—Andreoli Open Ozoniser.

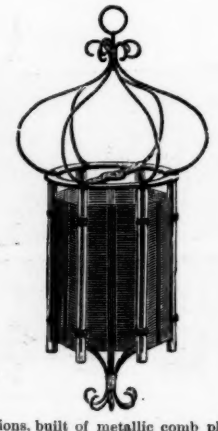
Between the points of the combs are fixed glass tubes containing each a metallic rod acting as electrode; when the current passes, silent discharges are effected, and the air circulating within and around the instrument is rapidly

ozonised to an appreciable extent without any artificial draught.

In these open apparatuses there is no rise of temperature, which, as is well known, tends to retard the production of ozone.

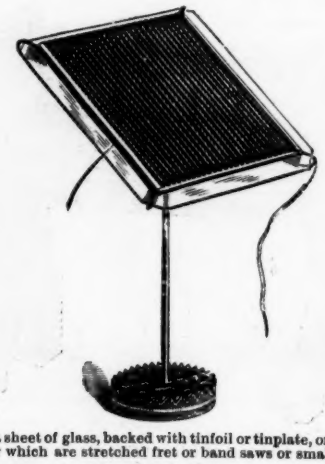
Open ozoniser constructed on the same principle as the ozoniser for suspension, and of which the glass tubes containing metal core are secured by wires coiled around them and soldered to the combs.

Fig. 27.—Andreoli Lantern Ozoniser.



Ozonisers for suspensions, built of metallic comb plates forming one of the electrodes and fixed on a flat ring connected by radial arms to a central axle fitted with a hoop.

Fig. 28.—Andreoli Suspended Ozoniser.



Consisting of a sheet of glass, backed with tinfoil or tinplate, or of an enamelled metal plate, over which are stretched fret or band saws or small serrated wires.

Fig. 29.—Andreoli Music Stand Ozoniser.

The above engravings show that this novel arrangement for the production of ozone is characterised by the employment of metallic points, corners, angles or asperities on which the electric tension is at its maximum, and from which electricity is discharged much more freely than from a flat or an undulated or corrugated surface.

THE TELEPHONE IN VIENNA.*

As various incorrect views have been recently promulgated on the arrangements of our central station, on the cables which we employ, the apparatus, &c., we have requested Prof. J. Hopkinson, who is known as one of the most efficient and respected specialists in the sphere of electrotechnics, and who has been especially recommended as such by the Royal and Imperial Austro-Hungarian General Consulate in London, to subject our telephonic installation here in Vienna to a thorough investigation, and to report on it as compared with the telephonic installations in London, Paris and Berlin.

Dr. J. Hopkinson is a Fellow of the Royal Society, professor of Electric Engineering at King's College, London, member of the Institution of Civil Engineers, and past President of the Institute of Electrical Engineers, and we take the liberty of sending you a copy of his report, in the belief that it would be of interest to your circle of readers.

(Signed) R. Howard Krause,
On behalf of the Vienna Private Telegraph Company.

Extract from the Report on the Vienna Telephonic System.

I have undertaken a careful examination of the Vienna telephone system, with the object of furnishing a report on the working capability, and the value of the installation, from a technical point of view. I am personally acquainted with the telephone systems of London and Paris, and I have a general knowledge of the system at Berlin, and a personal experience as to its performance.

In order to pronounce on the capabilities of a telephone system, three points have to be decided:

1. Is the speech of the persons conversing transmitted loudly and distinctly?
2. Is the system practically free from noises other than those produced by the persons conversing?
3. When a subscriber calls up another, is his wire quickly connected with that of the latter?

In all these respects I find the Vienna telephone system excellent.

The speech is loud and distinct, louder and more distinct than that in London, Paris, or Berlin.

The system is sufficiently free from noises derived from sources other than the conversation of the persons.

The wires are not always quite silent; extraneous noises, such as telegraph instruments, calls on other wires, are occasionally audible. Among many observations a person speaking on another wire was once overheard, but it was quite impossible to conjecture what was being said. These are effects of induction. It is, of course, possible that in case of contacts, extraneous sounds may be rather louder; but these are exceptional cases which occur everywhere. Such hearing is occasional, and can be remedied in every individual case. In this respect Vienna is better than London or Berlin, but not as good as Paris, where the wires are generally quite silent.

As regards the rapidity of connecting the subscribers with each other, Vienna is the best large telephone net which I know of.

In the cases which I have observed, it took from 25 to 75 seconds in order to effect the connection of subscriber to subscriber after the first call had been given. It may be that in very busy times rather more time may be required, say 90 to 100 seconds. According to my observations it should not last longer. In Berlin the time spent was 1½ to 2 minutes; in Paris, according to the observations which I made there, from 3 to 4 minutes, though I was told that it often took much longer. In London I have tried various calls and noted the time required. The shortest interval which I have observed, if connection had to be made through two exchanges, is 1 minute, but I have also observed 2¾ minutes and 5 minutes. According to my general experience, I should say that the average time spent was about 2 minutes.

This advantage of speedy connection results chiefly from the fact that in Vienna there exists a *single exchange*, with three multiplex switches, whilst in London there are many separate exchanges connected by main lines, in Paris 12 exchanges, and in Berlin, including the suburbs, 12 or 13 exchanges.

Both in Paris and Berlin there prevails an endeavour to reduce the number of exchanges.

* *Neue Freie Presse*, Vienna.

In Vienna, underground cables run from 1 to 4 kilometres from the exchange, in all cases with double wires.

That disturbances are heard on the Vienna line is because many wires run above ground and have an earth connection. They are trifling, however, since where the wires lie nearest to each other, especially in the cables, they are double.

In Paris, in consequence of the peculiar arrangement of the sewers, it is possible to carry the wires into the house-sewers of the subscriber without using any above-ground leads. The nature of the Vienna sewers renders such a connection impossible.

The Vienna cables are certainly remarkably durable. It was told me that among more than 70,000 cable wires which were laid, only 20 were found in any way faulty, and that these defects were due to mechanical injuries. I have caused troughs to be opened and have tested the condition of the cables, and I could find no reason why they might not remain for an indefinite time in their present condition. To employ more costly cables would be useless luxury.

There are three switches; these are multiplex with double wires. There are ample connections between the three switches. This is easily effected, because the three switches are in one building. The switches can serve more than 8,000 subscribers, with two wires for each subscriber. A part of the switches are so arranged that each lead can be made to serve two subscribers, if such arrangements should be found necessary in future. All the appliances of the switch are of remarkably good construction, and far more substantial than those of the Western Electric Company, which is known as the best manufactory of switches.

The apparatus used in Vienna is extremely good. The inductors (? magnetos), especially, are the most substantial which I have seen anywhere.

I am informed that the subscribers in Vienna pay yearly 100 florins (£8 8s.), if they are within 2 kilometres from the exchange. In London they pay £20 (240 florins); in Paris, £16 (192 florins); and in Berlin, within 1 kilometre from the exchange, £7 10s. = 150 marks = 90 florins. If we consider that the Austrian Government exacts per subscriber a yearly tax of 12 florins = £1, the charge for the telephone service at Vienna is remarkably reasonable.

In conclusion, I am of opinion that the Vienna telephone system fulfils every reasonable demand. It is better than London, Berlin, and better than Paris in distinctness of sound and expedition in service. Vienna is inferior to Paris only in this respect, that, from the causes explained above, the wires are not absolutely silent; still, the disturbance is so slight, that the noises, though audible, cannot irritate the most sensitive ear.

The cost of that part of the entire installation which I was enabled to test is moderate.

(Signed) J. HOPKINSON.

Vienna, January 8th, 1893.

A PHOTOGRAPHERS' ELECTRIC PENCIL.

THIS pencil is used by photographers for dodging or retouching photographic negatives.

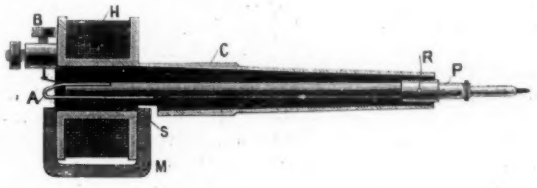
In retouching the defective lines or spots on a negative, the stroke of the pencil requires in many cases, in fact in almost every case, to be minutely small, and therefore to obtain the desired effect is a very slow process, as these small strokes have to be made with great care.

Recently an American firm introduced a pencil which is rapidly revolved by a small electromotor so that the point of the pencil spins, and thereby is rubbed on to any spot by simply moving the point gently over it in any desired direction, thus doing away with the necessity for the tiresome confined motion of the operator's hand.

Another method and apparatus also recently introduced from Germany consists in fixing the negative in a frame, which is vibrated rapidly by an electro-magnetic apparatus.

The appliance herein illustrated is a British production, and in it the pencil point is very rapidly vibrated through an exceedingly small stroke by a simple electro-magnetic contact breaker, so that the pencil has only to be guided by the operator while the electro-magnet performs the necessary rubbing at an exceedingly rapid rate, about 2,000 strokes per minute.

It is claimed that this form is simpler and less liable to derangement than the rotating form.

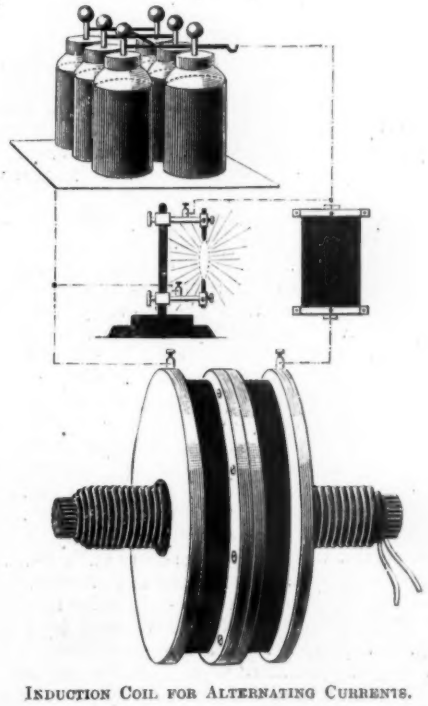


A battery of two large Leclanché cells works this vibratory pencil, and where a number are in use one contact breaker can be arranged to work them all. Referring to the figure, P is the pencil pivoted at R in trunnions, C is an ebonite case carrying a bobbin of fine wire, H, B is the contact breaker platinum screw point, A is the armature, a light piece of soft iron passing through the coil, M is a piece of soft iron fixed outside of the coil to which the armature is attracted. A spring, S, opposes the attraction and sends back the armature, which is fixed on the end of the pencil. It will be readily seen that the pencil point makes a small motion compared with the play of the armature.

AN INDUCTION COIL FOR ALTERNATING CURRENTS.*

BY R. W. WOOD.

AS the ordinary Ruhmkorff coil is not well adapted for use with alternating currents, and as no coils are on the market capable of being run to advantage by currents supplied for



INDUCTION COIL FOR ALTERNATING CURRENTS.

illuminating purposes, I think that the description of a cheap but powerful instrument will be of general interest to the readers of the *Scientific American*.

* *Scientific American.*

For spectroscopic and other work requiring a powerful discharge, it has been customary to employ a large Ruhmkorff coil in connection with a galvanic battery; but this form of apparatus, owing to the large initial cost and the expense of constantly renewing the cells, is not as suitable or economical as an instrument that can be run by currents, furnished at low cost for lighting purposes. The discharge, too, is far more powerful. My coil, when connected with a condenser of six one-gallon Leyden jars, the primary being fed with a 52-volt alternating current from a Thomson-Houston transformer, produces a discharge, the roar of which is so terrific, that it is unpleasant to remain for any length of time in its vicinity. The power of the discharge can, however, be decreased to any extent if the nerves of the experimenter require it. Such a coil can be constructed at an outlay of about $20, and can be operated for a few cents an hour.

The core consists of a bundle of soft iron wires 15 inches long by 2 inches in diameter. Great care should be exercised to obtain wire of a suitable quality. Ordinary so-called soft iron wire furnished by hardware dealers is wholly unsuitable. The best material is known as "core wire," and can be obtained from any large dealer in electrical goods. Around this core are wound two layers of No. 6 double-covered magnet wire, the core being first wrapped with one or two thicknesses of thick paper to prevent possible short-circuiting. It is not necessary to paraffin or varnish these layers, as there is but little tendency toward internal sparking in a coil of this description.

The form of the secondary coil is quite different from that generally adopted by makers of induction coils. Instead of being spread out over the whole length of the primary, it is concentrated in the centre, in order to obviate the effect of the ends of the primary. It is wound on a double spool 14 inches in diameter and 6 inches in width. This spool is made in two sections, as follows:—Four wheels, 14 inches in diameter, are cut out of ½-inch well-seasoned wood, and a hole 3¼ inches in diameter bored in the centre of each. Two hollow wooden cylinders should then be turned, measuring 3 inches in length by 3¼ inches external diameter, and 2¾ inches internal diameter.

The wooden wheels will fit on to the cylinders, forming two spools, each having a space 2 inches in width for the winding of the secondary coil. It may be necessary to depart slightly from these dimensions, as the internal diameter of the cylinders should be large enough to allow of their slipping over the primary coil. The wooden pieces should be thoroughly boiled in paraffin until they cease to give off bubbles of steam. The wheels may then be glued securely to the wooden cylinders, taking care to have them as nearly parallel as possible. The two actions of the secondary should be wound separately with No. 30 cotton-covered magnet wire, of which 15 lbs. will be needed. The winding can best be accomplished by fitting a solid wooden cylinder within the hollow one and mounting the whole affair on a spindle turned by a crank or in a lathe. The end of the wire should be passed out through a small hole in the wooden disc close to the cylinder, and the wire then wound evenly and closely across the spool. After the first layer is wound it is brushed over with melted paraffin, which should be hot enough to thoroughly interpenetrate the strands. A strip of thick brown paper which has been previously soaked in melted paraffin is then fitted neatly over the layer and the ends fastened together with hot paraffin. The paper should come close against the sides of the spool, and the junction should be painted with paraffin to insure perfect insulation. The next layer is then wound and treated in the same way. It is difficult at first to wind the wire evenly and closely, but with a little practice the wire may be made to guide itself. If the turning is done by hand it is better to have some one to work the crank, and give one's entire attention to guiding the wire. The winding should proceed, each layer being brushed with hot paraffin as described, and insulated from its neighbour by the paraffined paper, until the wire is within three-quarters of an inch of the rim of the spool. If a break occurs in the wire, it should be neatly soldered and carefully insulated.

The second spool should be wound in an opposite direction from the first, so that when the two spools are placed side by side and the *internal* terminals joined, the direction of the wire will be the same in each. The exterior terminals should be fastened to binding posts and the interior soldered or twisted together, and the spools should then be fastened together by driving ¾-inch brass screws through the rims of the two inside wheels. Care should be taken to have them fitted exactly, so that the primary coil may pass easily through the centre of the bobbin. A fine finish may be given to the coil by ebonising the woodwork and covering each section of the secondary with a strip of thin hard rubber. If there is any spare room between the primary and secondary, it may be filled by covering the primary with black silk or a thin tube of hard rubber. A covering of some sort is necessary to prevent the heavy secondary coil from abrading the insulation of the primary. The coil is now finished. No interrupter, commutator or condenser is required.

The primary wire should be fed with an alternating current of about 52 volts, such as is furnished by the Thomson-Houston incandescent system. As soon as the current is turned on the coil will hum, and care must be exercised to keep away from the secondary terminals. The discharge differs curiously from the ordinary Ruhmkorff. Only a very small static spark can be drawn from a single terminal, by approaching the finger to it, and no discharge takes place between them until they are brought within a quarter of an inch of each other, and it is best shown between two carbon points. As soon as they are brought within striking distance a small arc will be established, and they may then be separated to a distance varying from two to four inches, according to the strength of the current in the primary. The arc emits but little light, and bends upward in a graceful curve with the current of hot air.

It is with the Leyden battery that the tremendous power of the coil can be shown. From six to ten gallon jars, or more of a smaller size, should be connected with the terminals of the coil, as indicated in the diagram; all the inner coatings being connected with one terminal, and the outer with the other.

The discharge now consists of a torrent of thick blue sparks, which give rise to a most deafening sound that is a combination of a hiss and a roar. The power of this discharge may be still further increased by putting into the circuit a coil of high resistance, as shown in the diagram, such as the secondary of a medium-sized Ruhmkorff, which adds to the capacity of the circuit. Great care should be taken not to allow the current to pass through the body, as the effects are very painful, if not dangerous. I have accidentally taken the current from my coil when running at about one-fifth of its full capacity, and do not care to repeat the experience. There was an awful wrench, followed by a sensation as of just awakening from an anæsthetic sleep. I imagine that the current produced complete unconsciousness for a fraction of a second, though I did not fall.

The powerful discharge from the coil used in connection with the Leyden jars is most admirably suited for obtaining metallic spectra, either for photographic or visual purposes. If the metal is easily volatilised, or in the form of a chloride, the arc obtained by using the coil alone will show the spectrum of the metal entirely devoid of the air lines which are always present when the bright spark from the condenser is used. The coil may be also used to advantage for operating large-sized vacuum tubes. A very pretty effect may be produced by allowing the discharge to pass between two carbon points in a low vacuum under the receiver of an air pump. If the points are first brought close together, in order to start the current, they may be separated as far apart as the dimensions of the receiver will allow, and there will be formed a beautiful arc of purple fire, a foot or more in length, surrounded by a white aureole of a pale yellow-green colour, and the receiver itself will shine with a pale blue phosphorescent light.

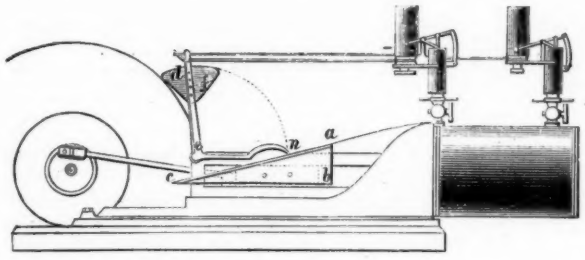
If the current feeding the primary is furnished by a transformer, the incandescent lights supplied by the transformer will be greatly dimmed while the coil is in action. This is because the primary acts on the transformer as a choking coil, lowering its electromotive force. If this is an inconvenience, as may often be the case, it may be remedied by increasing the self-induction of the primary. This may be done by winding a hundred or two turns of No. 15 double covered wire into a coil 3 or 4 inches in diameter, and slipping it over one end of the primary in such a manner that, when placed in circuit with the primary, the direction of the cur-

rent will be the same in the two coils. This will decrease the capacity of the coil to a great extent; but the discharge will be as powerful a one as it is comfortable to work with, when the jars are in circuit. It is a good plan to make a strong wooden stand for the coil, which will support the primary on each side of the secondary; and if it is necessary to move the instrument about much, it is desirable to mount it on chair castors, as it weighs nearly 50 lbs. The core weighs about 10, the primary 9, the secondary 15, the wood and paper about 4, and 8 or 9 lbs. of paraffin will be used in saturating the wood and paper and insulating the layers of the secondary.

What the physiological effect would be if the full current were taken I do not know. I doubt if it would be fatal, but it would be a very hard blow. Possibly coils of this description, built on a large scale, would be convenient for electrocutions.

A NOVEL INDICATOR GEAR.

IN testing an engine at Sibley College, as described in *Cassier's Magazine*, Prof. Carpenter employed a form of indicator gear which, to us, is novel, and as it has some features which should make it useful and convenient, we append a description of it with illustration. To reduce the motion of



the piston to the travel of the indicator barrel, there is attached to the cross-head of the engine an inclined plane in the form of a triangle, a, b, c, the side, c, b, of which, is made slightly longer than the stroke of the engine, and the side, a, b, is made a little longer than the desired travel, or diagram length. Pivoted at the end of the slide bar is a bell crank lever, d, e, n, in which e, d, is equal to e, n. The angle, a, c, b, is thus such that its tangent $= \frac{t}{s}$, s being the engine stroke and t the diagram length. This, of course, on the basis of the bell crank lever being equal armed.

The end, n, of the bell crank, slides on the sloping face of the cam, and the indicator cord is attached at d, and the arm, e, d, is of course to be exactly vertical when the engine is at mid-stroke. The motion is not exactly correct, as shown, for the point d rises and falls as it traverses its small arc of motion, but this may be corrected by adding a curved rim to the lever on which the cord may wrap; this rim to be struck from the centre, e. We have added this circular segment, f. Theoretically, too, n should be a knife-edge, to ensure accuracy. The convenience of this device is felt when taking many diagrams. The lever, e, d, may always be held back, so that n is held clear of the cam, and no movement is given to the indicator, and it can be as easily released into working position again. There is no fumbling with cords or taking up slack, and no frantic grasping after the cord hooks or the little tent rope tighteners; but, once fixed to length, the indicator cords may be left undisturbed. The inertia effects are said to be small, and there is not a great length of cord to stretch and render the diagrams untrue. Brass wire is said to be a fairly unstretchable material for the cord, and we have tried it, though not with special success in general work. This device, however, with its fixed and continuously stretched cords, appears to offer a chance for using wire without the disadvantages which, perhaps, others than the writer have found to accompany it.

ELECTRIC LIGHT AND GAS.

By Ed. C. DE SEGUNDO, Assoc.M.Insts.C.E. and E.E.

(*Concluded from page* 169.)

A CONSIDERABLE gap occurs between the previous portion of this paper and this one. The reason is that I have once more been making every effort to obtain reliable and authentic figures as to the money saving in redecoration in the case of such buildings as theatres, clubs, and other large public or even private buildings. It is a question whether such figures really can exist, as it is only recently—that is to say, within the last four years, that electric lighting has become so general, and it is therefore difficult, if not impossible, to generalise from so few data as one is able to collect. I would therefore propose in these concluding lines, to inquire into the amount that must be saved, in the various directions in which an economy is effected by the use of electricity over gas as an illuminant, in order to counterbalance the extra cost light for light.

Let us consider in the first instance the case of a private dwelling house decorated in the average way, that is, without any pretensions to artistic merit. It may be assumed that on such a house one year's rent in seven years will be expended in keeping it in proper repair, and of this 50 per cent. may be taken to fairly represent the "repairs" of such portions as are liable to be affected by the method of illumination. Taking the rent at £90 per annum, we may consider that £45 will be spent every seven years for painting and papering, or on the average £6 10s. per annum. Now the average gas bill per annum in such a house as this, would be about £10. The cost of electric supply, as we have already seen, may be taken as 70 per cent. more than gas light for light, or in this case £17 per annum. But it has also been seen that a considerable saving, amounting in some cases to 25 per cent. of the total burning hours, can be effected by the exercise of a little care owing to the ease with which the electric light can be turned off when not required. Assuming that 15 per cent. of the hours of consumption are saved, we arrive at (£10—15 per cent.) $1{\cdot}7 = 8{\cdot}5 \times 1{\cdot}7 =$ £14 9s. as the probable equivalent cost of electric light in this particular case. To bring this down to the cost of gas, or £10 per annum, we have to show a saving of £14 9s.—£10=£4 9s. We cannot of course save the whole of the £6 10s. per annum, which may be assumed to be the average expenditure per annum on painting, papering, &c.; but it is fair to assume that one half, or £3 5s., will be saved, leaving £1 4s. per annum still to be accounted for. It is not legitimate to despise £1 4s. as being almost a negligeable quantity, because it represents 12 per cent. of our gas bill; but it is legitimate to ask whether in all human probability this amount is not counterbalanced by the decrease in damage to furniture, books, picture-frames, and, last but by no means least, an enhanced purity of the atmosphere breathed by the occupants of the house?

It may be objected that I have allowed nothing for increase in expenditure of fuel owing to the fact that electric light does not warm a house. I can only say that my own experience of my own house is that, especially on winter evenings, the rooms used to get so stuffy when lighted by gas that the door had to be frequently opened and the cold air got in that way. Of course it is possible that I am hypersensitive as regards "stuffiness," or that the rooms were not properly ventilated. There were two patent ventilators in each room, but they persistently refused to act when the wind blew from any but one special ventilating point of the compass; and when the wind did happen to get in that quarter it certainly did its very best to get into the room as well, so that after much long-suffering experiment the ventilators were permanently sealed. It is really remarkable how terribly behind hand we are in that all-important matter, the proper ventilation of public places and dwelling houses.

However, architects are doubtless the best friends of the electric light, so those interested in the progress of this branch of industry must not complain of the want of ventilation of buildings.

Now, as regards clubs, theatres, and such public buildings. It is clear that no great saving in the burning hours can be effected in these cases. A club must always be properly lighted throughout, as members cannot be expected to refer

to a plan of the club to discover which switch operates which light before entering a room.

But the cost of redecoration of a club or theatre is a much more serious matter in proportion than that of redecorating a private house. The members have to be accommodated elsewhere for the time being, and this means a great loss and diminution of income to the club, while the outgo in rent, salaries and wages is just the same, or nearly the same.

Suppose a club to have 400 gas burners, each burning on the average, 1,500 hours throughout the year and each consuming 5 cubic feet of gas per hour, this at 3s. per thousand would amount to about £500 per annum. The extra cost of the electric light, if derived from a supply company's main, light for light would be about £350 per annum. Suppose the weekly expenses in salaries, wages, &c., to be £100, a complete redecoration of the interior of the premises would take, say, six weeks and would cost, say, £1,500. The income lost by the absence of members' custom would be not less than £150 per week, so that the complete redecoration would actually cost about £3,000. It is usually admitted that any electrically lighted public building requires renovation half as often as a gas lighted one. Supposing, then, that one-half of £3,000 or £1,500 is saved every seven years, this is at the rate of £210 per annum, which will materially help to pay the £350 increase of cost over gas. But the saving in damage to furniture, carpets, books, and other articles which cannot be renovated, but can only be replaced by new ones, would account for the remaining £140, so that it may fairly be said that the electric light would pay for its extra cost over gas in a club of any size, even if the supply were drawn for the public company's mains. But a club, owing to the regularity of the burning hours, can be economically lighted by a gas or steam plant when the number of lamps approaches 500 8-C.P. Assume that in our former example each gas burner is replaced by a 60-watt lamp, the annual consumption would be 36,000 units. Allowing 50 cubic feet per unit at the dynamo terminals, the cost of working by a gas engine, without accumulators, would be

	£
Gas at 3s. per thousand $\frac{36{,}000 \times 50}{1{,}000}$ = ...	270
Lamp renewals (at present price of lamps) ...	80
Extra wages for attendant, repairs, &c., engine and dynamo	70
Interest on outlay and depreciation	100
	£520

or, roughly, about the cost of gas. But this amount would be reduced by about £50 after the expiration of the patents which virtually constitute a monopoly in the manufacture of lamps.

The foregoing figures relating to a club do not, of course, apply to all clubs, but the majority of old established, well attended clubs, would probably find it worth their while to replace gas light for electric light, even on the score of cleanliness, and the economy attendant upon it, apart from any other reason. There are, of course, clubs that pride themselves on being old fashioned, and behind the times, and who prefer to burn candles, or even oil, but these cannot certainly be taken as representative of the feeling of the majority in the present day. It is safe to say that if the same drama were being performed by equally good casts at similar prices in similar theatres, of which one was electrically lighted and the other lighted by gas, the latter theatre would be patronised only by the overflow from the electrically lighted one. There is an undefinable charm about the electric light. It is such a clean pure light, it lends itself so readily to artistic combination and effect, there is so little risk of fire, and it is so easy to put down and light again, that the extra money cost is being rapidly discounted, as the before-mentioned characteristics become more widely realised and appreciated. When experience shows what I have attempted to forecast in this article, namely, an actual saving over gas, in addition to the many advantages above alluded to, this in conjunction with the decrease in the cost of lamp renewals and the wholesome competition between electric supply companies, will greatly tend to popularise the electric light, and will enable its use to be extended farther and farther into the domain over which gas, even as an illuminant, may for the present be considered to hold an undisputed sway.

ECONOMY OF A NON-CONDENSING COMPOUND ENGINE.

In *Cassier's Magazine* the economy of the compound high-pressure engine is well considered by Prof. Carpenter, of Sibley College. He states that numerous tests have fairly well determined the economy of condensing engines of both simple and compound type, but as yet little has been done to fix the status of the compound high-pressure engine. The subject is, we may confess, surrounded with practical difficulties. In one of its most interesting developments the compound engine has been tried in positions which were in every sense in favour of its success. We refer to the compound locomotive. Apart from the mere value of increased pressure, which may be said to belong to the compound engine by right, there is no doubt that in comparing it with simple engines it has been given advantages in the shape of larger cylinders and a compulsory higher rate of expansion, which might very fairly be claimed as sufficient in themselves to secure all the economy shown by the compound engine. The present writer knows of no test of a compound locomotive in which there has not been a decided advantage given to it, in respect to its dimensions, over the older simple engines with which it was called on to compete. Treating the question from a thermo-dynamic standpoint, the professor gives a table and a diagram showing by four curves the consumption by a perfect steam engine of heat in B.T.U., and of water in pounds per horse-power hour for the two cases of back pressure, 14·7 lbs. and 5 lbs., for steam pressures up to 200 lbs. We reproduce the table, which is based on Rowland's determination of the value of the heat unit, namely, 778 foot-pounds in the latitude of New York. The diagram shows how, with a higher initial steam pressure, a larger percentage of the heat entering the engine becomes available for work.

By a perfect engine, of course, is meant one which realises the efficiency expressed by $\frac{T_1 - T_2}{T_1}$ in absolute temperatures. The diagram shows the non-condensing efficiency for low pressures to be very small, only 2·6 per cent. for a pressure of 25 lbs. (about 10 by gauge), and yet as high as 20·2 per cent. for an absolute pressure of 200 lbs. The non-condensing engine is thus eight-fold better at the high than at the low pressure, whereas the condensing engine only improves from an efficiency of 10·9 to 26·2 for an equal increment of pressure.

In seeking a cause for the failure of an engine to attain the theoretical efficiency, our author appreciates the reduction of the loss, due to cylinder condensation, by the use of compound cylinders, but cannot explain why a slight temperature change in a large mass of metal should waste less heat than a larger change in a small mass of metal, which, in a few words, expresses the difference between the action of cylinder condensation in the two types of engine, though he admits the fact is sufficiently proven by numerous tests, which show the superior efficiency of the compound system.

To the writer this does not appear specially strange: the first cylinder exposed to the hottest steam is small, and any loss in it, due to condensation, is saved in the next cylinder, and performs work before being finally lost. Except, of course, the heat converted into work, no heat enters the first cylinder without, in some form, reaching the second, and as the steam is more or less wire drawn in its passage, there is a tendency to superheat, which may explain how comparatively dry second cylinders frequently are found.

Then, again, something must be due to merely mechanical causes. In a simple engine the whole circumference of the piston and valve is exposed to the full steam pressure, and ready, if the least bit faulty, to pass direct boiler steam to the condenser or atmosphere. Not so the compound engine, which divides both its temperature range and its pressure range, and reduces as well the peripheries of leakage for boiler steam, and the area of radiation surface exposed to boiler temperature. Everything favours the compound engine, and perhaps nothing more than the reduced effects of wear and tear, for these are less in amount, and have less influence for evil in the compound system. To test the practical efficiency of a non-condensing compound engine, Prof. Carpenter tested one of Tandem variety, with cylinders 8 inches

and 14 inches diameter, of the ordinary overhung cylinder type, with shaft governor.

The usual precautions were taken, which are familiar to those accustomed to engine testing; but as it was not possible to measure the feed water, it was necessary to condense the steam exhausted by the engine, which was done by a surface condenser, connected with a small double-acting air pump, run at a slow speed, determined upon experimentally as giving the same back pressure as would have existed had the exhaust gone direct to the atmosphere. The effect of non-condensing was thus claimed to be secured by a condenser vacuum of one pound, which was maintained at this by an air inlet valve which shifted in a little air each stroke.

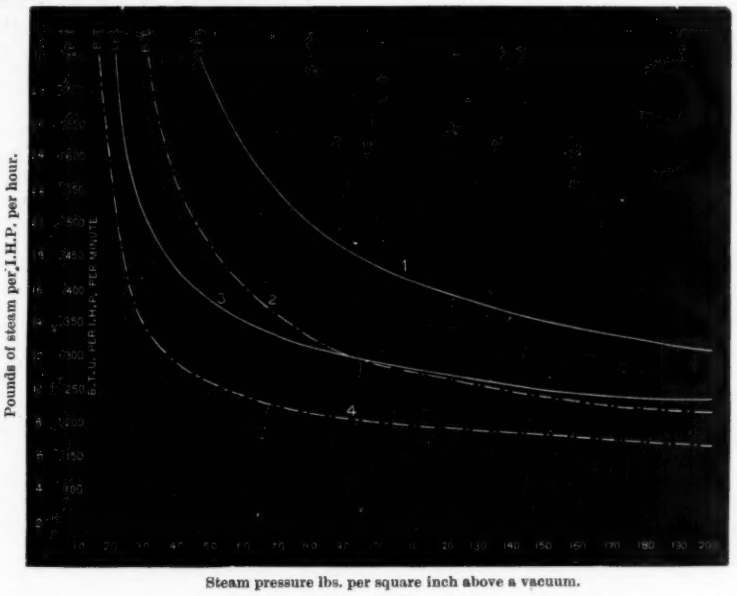
The average load was 50 H.P., and the speed 97 revolutions per minute. The consumption of steam was 22·6 lbs. per horse-power hour, the boiler pressure being 125 lbs. by gauge (nearly 140 absolute), at which pressure the perfect engine would consume about 14·6 lbs., the actual efficiency being thus about 64½ per cent.; a better result than might have been expected for so slow a speed.

The indicator diagrams measured at the terminal pressure accounted for 76 per cent. of the steam used. The author considers that the tests are sufficient to indicate that compound non-condensing engines may be expected to work with from 22 to 24 lbs. of steam, if with an initial pressure of 110 to 125 lbs., and by comparing the results obtained with various conditions of load, he arrives at the conclusion that for any horse-power the probable steam consumption may be calculated as follows, for an engine of a certain rated power.

Knowing the steam consumption at that rated power, and calling w the waste or excess of steam over the consumption, as per diagram of the perfect engine, we get the steam consumption per I.H.P. = s.

$$s = w \sqrt{\frac{\text{Rated H.P.}}{\text{Given H.P.}}} + \text{consumption of perfect engine.}$$

For example, in the case of the engine tested at 22·6 lbs.



Steam pressure lbs. per square inch above a vacuum.

1, Pounds of steam per I.H.P., back pressure 14·7 lbs.; 2, B.T.U. per I.H.P., 14·7 lbs. back pressure; 3, Pounds of steam per I.H.P., back pressure, 5 lbs. 4, B.T.U. per I.H.P., 5 lbs. back pressure.
Economy curves of a perfect engine, non-condensing, atmospheric back pressure, also condensing, five pounds back pressure.

POUNDS OF DRY STEAM AND B.T.U. PER I.H.P. REQUIRED BY THE PERFECT ENGINE.

Steam pressure. Absolute.	Temp. of steam. Degrees Fah.	Back pressure, 14·7 lbs. [212°]. Thermal efficiency. Per cent.	B.T.U. per I.H.P. per minute.	Dry steam per I-H.P. per hour.	Back pressure, 5 lbs. [162·5°]. Thermal efficiency. Per cent.	B.T.U. per I.H.P. per minute.	Dry steam per I.H.P. per hour.
25	240·	2·6	1,620	100·05	10·9	388	22·8
30	250·3	5·35	740	48·8	12·4	340	20·0
40	267·1	7·55	560	34·2	14 7	287	16·8
50	280·9	9 2	465	28 0	15 95	266	15·4
60	292·5	10·55	400	24·0	17·25	245	14·2
70	302·7	11 8	364	21·8	18·4	230	13·2
75	307·4	12·4	340	20·6	18·9	224	12·85
80	311·8	12·95	328	19 7	19 5	217	12·5
90	320 0	13·85	306	18 3	20·5	206	11·85
100	327·6	14 7	288	17·3	21·1	200	11 5
125	344·1	16·4	259	15·5	22 7	187	10·7
150	358·2	17 85	240	14·1	24 0	177	9·9
175	370·6	19·1	221	13 0	25·1	169	9·55
200	381·7	20·2	208	12·4	26·2	162	9 20
		t	b	s	t	b	s

Formulæ—Let λ = total heat supplied,
q = heat (sensible) at back pressure,
T = absolute temp. entering steam,
T_1 = " " " discharge "
Then t = thermal efficiency = $(T - T_1) \div T$,
B.T.U. per I.H.P. per minute = $42·42 \div t$.
Dry steam per I.H.P. per hour = $25·45 \div t\ (\lambda - q)$.

Knowing the steam consumption at that rated power, and calling w the waste or excess of steam over the consumption, as per diagram of the perfect engine, we get the steam consumption per I.H.P. = s.

$$s = w \sqrt{\frac{\text{Rated H.P.}}{\text{Given H.P.}}} + \text{consumption of perfect engine.}$$

For example, in the case of the engine tested at 22·6 lbs. and 50 H.P., the waste or excess is 8 lbs., and the consumption for 12½ H.P. would be

$$8 \sqrt{\frac{50}{12·5}} + 14·6 = 30·6 \text{ lbs.}$$

From which we may infer that the effect of great load variation is less in highly economical engines than in wasteful engines.

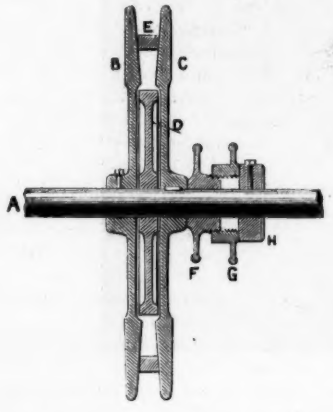
VARIABLE SPEED POWER TRANSMISSION.

A PAPER upon this subject was presented by Mr. H. C. Spaulding before the recent meeting of the American Society of Mechanical Engineers.

It is not long since a writer in the ELECTRICAL REVIEW expressed an opinion that could something be devised to effect this, it would be advantageous in admitting of the possibility of running steam engines at variable speeds in place of varying the expansion ratios, for an engine could always be run at the economic load in dynamo driving. For so expressing himself, he incurred the wrath of an American writer, who expressed himself in a powerfully abusive manner as to the extreme idiocy of the suggestion. The suggestion was made in the ELECTRICAL REVIEW of July 22nd, 1892, and should the device, we now illustrate, prove successful, it will exactly meet the want in many cases.

It seems somewhat fitting, therefore, that a method of securing the end indicated should be now described before a leading American society. Mr. Spaulding briefly refers to the ordinary speed cones and points out their narrow limits and the small number of variations possible within a reasonable bulk of apparatus, as well as the impossibility of making the change of speed without stopping the machine driven. He does not overlook the well-known cone drums of the roving and other spinning frames of the cotton mill, whereby

a gradual slow change of velocity is given to the revolutions of the flyer on the bobbin to ensure the even winding of a filament upon a diameter which changes with each ply of yarn, an excellent device for a small power and a slow change. The disc and runner, too, is not forgotten, but we all know its disadvantages accruing from small contact area. Nothing, however, has hitherto been designed suitable for rapid change of speed, but the apparatus described has features which render it worthy of attention. It is the invention of Mr. Gordon, of Dover, New Hampshire, and consists of a pulley deeply grooved and split into two in a direction transverse to its axis. The sides of the deep groove incline from the parallel, being wider apart at the outer circumference, in such a way that a thick and stiff belt will take a bearing upon the sides of the groove. It is thus easy to see that by varying the distance apart of the two halves of the pulley, the belt will take its bearing nearer to, or further from, the circumference, and thereby vary the speed of rotation. The belt cannot be unshipped or slipped laterally from a fast to loose pulley, but this has been ingeniously provided for by fitting the loose pulley between the two halves of the fast pulley, whereby, upon a sufficient separation of the cheeks, the belt will drop upon the inner loose pulley. In the figure a convenient form of the device is seen.



A shaft, A, carries the two halves of the split pulley, B and C, of which B is firmly keyed to the shaft, and C slides on the shaft upon a feather key, which prevents its rotation. H is a collar fast on the shaft and serving as a thrust bearing to a combination of F and G, which, in this case, consists simply of a male and female screw device for varying the length of the combination. Either F or G may be held from rotation when desired, and the space occupied thereby lengthened or shortened, so varying the gap between the inclined faces of B and C, and compelling the belt, E, to take its bearing on a different radius. D is the loose pulley, freely turning on the shaft, which receives the belt when the width of jaw becomes so great as to let the belt drop so far.

The belt, we are told, may be of round or of nearly square section, though, so far, most of the experiments have been made with a narrow double ply belt with edges bevelled to the pulley face angle.

The device has not yet been sufficiently tested to prove its capabilities, but there appears nothing to indicate that it will not do that which is claimed for it. It seems to afford what has long been called for—a means of running a rope upon a loose pulley—a want which has often caused the rejection of rope-driving in many places where ropes seemed peculiarly desirable. The difficulty as to varying slackness of the belt may be overcome either by a jockey pulley or by applying the principle to both the driver and the driven pulleys, the one expanding and the other contracting by equal amounts, so as to preserve the same relative length of belt. This would not be difficult to arrange, and the proper working of the pieces F and G will suggest itself readily to those who have had experience of similar devices. One difficulty appears prominent, namely, the application to large powers necessitating large belts or many ropes in the present style of driving. The new pulley might then prove too cumbersome, but for purposes where a single band is sufficient, the device would be valuable, and quite large powers could be obtained with but one band, which might be made 2 inches thick or 10 times the thickness of an ordinary thin belt, so securing several hundred horse-power with a belt of only 3 or 4 inches in breadth, if properly jointed. We may remember in this connection that a square leather rope 1½ inches × 1½ inches, will transmit 50 I.H.P. at a speed of 80 feet per second, which is probably not the maximum economical velocity for leather as it is for cotton ropes.

Engineers who like ropes would do well to watch the progress of this new pulley; it certainly holds forth a good promise for the possibility of varying the rotative speed of engines to suit the absorption of power by the dynamos they are driving. Probably some toggle joint movement would replace the screw combination of F and G, and it may be the angle of the wedge groove would be more obtuse than our sketch shows.

It will be perceived that the effect of the device upon the belt will be to cause this to travel at its highest speed when doing maximum duty, which is what should occur. It might be worth the consideration of some ingenious mechanic whether use could not be made of the torsion in the shaft between an engine and a dynamo or other machine to effect the change in the positions of B and C necessary to suit the speed of the engine to the torsion in the shaft, and therefore, of course, to the duty. Such a device at least would possess the merit of answering with almost electrical instantaneity to every change of load, and a torsion governor would thus at once adjust the belt velocity, the piston speed and the steam supply to the work done. The belt would be exposed to less change in its unit tension and this would at least be no disadvantage.

THE ELMORE COLLAPSE.

The spirit of recklessness which was responsible for the production of the Elmore Companies, and has been characteristic of their management, has also deferred the evil day for facing the situation, so long as there remained a shilling in the locker, a mortgageable security on hand, or a possibility of extracting another sixpence from the public pocket.

The shareholders of the French Company have taken the wise course of obtaining independent reports. The other companies have formed committees, and they will doubtless be in a position to disclose the exact state of affairs in the case of each company. To ascertain the full measure of public loss requires more information than is at present available, but in order to arrive at an approximate idea, we draw attention to the following figures, which are taken from the latest published accounts, viz.:—Elmore's Patent Company to June 30th, 1892; Wire Company to October 31st, 1892; Foreign and Colonial Company to December 31st, 1891; French Company to December 31st, 1891; German Company to December 31st, 1891. Of the American Company no accounts have been issued, and the figures are taken from the prospectus.

The liabilities on shares, loans, creditors, &c. at the dates mentioned, were as under for the respective companies:—

	£	s.	d.
Elmore Patent Company	227,243	9	4
Wire Company	211,119	9	10
Foreign and Colonial	125,008	3	1
French	332,177	6	7
German	234,586	13	1
American	200,000	0	0
Total	£1,330,135	1	11

	£	s.	d.
The Elmore Patent Company held Wire Company shares to the amount of ...	11,958	9	0
And the Foreign and Colonial Company held French and German shares, debentures, &c., to the amount of	175,020	11	0
Dividends have been paid by some companies from the proceeds of shares which form the liabilities of others, viz.—Elmore Patent	70,000	0	0
Foreign and Colonial	75,000	0	0
	£331,979	0	0

Deducting this from the total liabilities, there remains in round figures the sum of £1,000,000 as the net amount involved.

According to the latest information given at the meetings, nearly all the companies are without available resources, so that in considering the assets the most important items are those relating to land, buildings, machinery, plant, furniture, &c., which are as under :—

	£	s.	d.
Elmore Patent Company	109,942	17	5
Wire Company	86,954	2	2
Foreign „	128	3	4
French „	110,964	12	9
German „	50,000	0	0
American „	...	...	
Total	£357,989	15	8

A further valuation of the French buildings, &c., reduced the figures as they stood in the accounts by nearly one-third, and the expert who reported on the works states it as "very certain that in the event of a forced sale they would realise very little indeed in comparison to the immense sums expended on them."

If therefore we estimate the value of the buildings, plant, &c., at £250,000, it will probably be found to be a very liberal estimate as going concerns. Deducting this from the £1,000,000, we obtain £750,000 as the possible public loss. We give the details of our estimate in order that it may be readily corrected by those having fuller information, and we call attention to the fact that some part of the liabilities is composed of cross entries from company to company for shares, &c. Furthermore, payments to vendors have been partly in shares, but, we believe, there were no restrictions on the sale of these shares. If they are held by the vendors, the public cash loss will be less; but we have no means of ascertaining whether they are held or have been sold. There is too much obscurity to justify taking any figures as decisive, but it is obvious that from one half to three-quarters of a million sterling is involved.

Whilst on the subject of figures, we may tabulate the values of the patents as they stand in the accounts of the various companies as assets :—

	£	s.	d.
Elmore Patent Company	81,321	16	4
Wire Company (license)	111,940	0	0
Foreign and Colonial	80,000	0	0
French	183,375	0	0
German...	165,000	0	0
American	180,000	0	0
	£801,636	16	4

This, of course, does not represent the amount paid to the original vendors, as they sold to Elmore's Patent Company and the Foreign and Colonial Company, who resold to the other sub-companies at greatly enhanced figures. But the £800,000 represents what the companies regard as their most valuable asset to compare with their liability of £1,300,000.

It was in January, 1889, that the public was first asked to participate in the benefit which was to be brought about by a revolution in the copper industry through the instrumentality of the Elmore process; £200,000 would have been the outside loss if it had stopped there, but, unhappily, it did not stop there. The scandal grew to its present proportions. It has been truly said that it is easy to be wise after the event. Such an excuse may even now be urged by those upon whom responsibility sits lightly. It is our duty to call attention to the fact that those upon whom the responsibility rests have not incurred their responsibilities with their eyes shut. From time to time we have indicated the inevitable drift of affairs Elmore. In the beginning we pointed out that the Elmore process was little more than a promoter's puppet, and those who incur responsibilities with their eyes open, must expect some day to have to face them. The responsibility, in the present case, has to be shared between the vendors, the promoters, and the directors.

On October 31st, 1890 (p. 510), we wrote :—"Inventors are expected to be sanguine, but to the promoters more than the usual responsibility attaches, on account of their well-known connection with the electrical business, and the pledges which they have given that their thorough examination of the system had satisfied them of its value."

The responsibility of the directors has been incurred, in the first place, by paying away immense sums for the patents of an unproved process, and in the second place, by the subsequent disposition of the funds placed in their trust. As to this, we wrote in the article above referred to :—

"To the shareholders of the subsidiary companies we venture to repeat the advice which we gave before. Keep the money you have in hand, and don't proceed with the work set out for you until the parent company has shown that there is a commercial success in the Elmore process. There is nothing unreasonable in this. All that will be lost is time, and that can be made up with the good start which the experience of the parent company will give you. There is no reason to suppose that France and Austria are so hungering for Elmore copper, that by a few months' delay a market may be lost never to be regained. Energy, enthusiasm and enterprise are very well in their way, but we recommend a strong infusion of caution as well."

"To the parent company we would say: You have received valuable consideration for the rights with which you have parted, and it is your duty to carry the process to a successful conclusion, if you can; but not necessarily to throw good money after bad, if your expectations of a Golconda show unmistakable signs of being misplaced."

Had the directors exercised the most elementary caution, even after the first start, much money might have been saved. Instead of care and caution, they have practised recklessness and waste. That is placing the most charitable construction upon their actions. A less charitable construction would be to suggest that the shareholders' money has been used for the purpose of deceiving the shareholders. That the shareholders have been deceived as to their prospects by ingenious statements at general meetings, we do not hesitate to say. It will be for the shareholders to ascertain whether there was at any time any justification for putting down numerous plants for the output of hundreds of tons, when the demand for tens of tons was extremely problematical, and it will be for the shareholders to ascertain whether the directors, instead of giving due consideration to such matters, preferred to invest more money in plants, either as a proof of their *bonâ fides*, or for the purpose of continuing an "Elmore boom" for a somewhat longer period. We can quote again from our own columns (October 10th, 1890, p. 414) a question which the shareholders may be disposed to ask the directors now :—

"The figures upon which the directors base their calculations are the figures of one of the original vendors; the managers of the works in which any practical work may have been done being also among the original vendors.

"The question we are naturally inclined to ask the directors is whether, in a matter of such importance, it is altogether wise to base so much on the estimates of those who might reasonably be expected to develop a sanguine temperament."

But it is useless for us to overlook the fact that the shareholders are not free from blame either. When they realise the full measure of their loss, they will undoubtedly be irate. The temper of the French committee as represented by the chairman was admirable in its judicial impartiality and freedom from casting reflections. If they can sustain that attitude to the end it will be of advantage, but there is certainly a danger that the complaisant shareholders who readily swallowed all the pabulum provided for them may as readily develop an opposite spirit. The Elmore affair has assumed such proportions as to make a complete enquiry a foregone conclusion. It should be conducted by the shareholders thoroughly, and with an intention of placing the responsibility on the right shoulders, and most certainly with one idea prominently forward: that is, that any vendor who is possessed of funds derived from the Elmore companies has, so far as present appearances go, derived profit without conveying adequate consideration. We are not now considering the matter as a legal one, but equitably the money has not been earned and should be repaid.

Woolwich Electric Lighting.—The London County Council have formally disapproved of works proposed by the Woolwich District Electric Light Company, details not having been supplied.

NOTES.

Deaths and Accidents Caused by High-Tension Currents.—The *Moniteur Industriel* has just published the following summary of the labours of Professor D'Arsonval on deaths and accidents caused by high-tension currents. M. D'Arsonval lately presented to the Biological Society the conclusions of an experiment made by M. Francis Biraud at M. Lacassagne's laboratory at Lyons. This work constitutes the first complete monograph published on the subject, thanks to the inquiries which MM. Lacassagne and Biraud made of electricians throughout the world. M. Biraud's study gives a very complete description of the fulguration accidents caused in the electrical industry, the relation of electrocutions practised on men and animals in America, and, lastly, some experiences personal to the author. The conclusions deduced from these observations, moreover, agree remarkably with those M. D'Arsonval has formulated since 1887. Electricity appears to kill in two manners, as follows: 1. By producing mechanical lesions of the vessels and nervous system. 2. By inhibiting the great functions wholly or partially (stoppage of respiration, of the heart, of the exchanges between the tissues and the blood, &c.) The first kind of death is especially the fact of the action of lightning and the static discharges of powerful batteries; in a word, it accompanies disruptive discharges. It is scarcely ever encountered in cases of industrial fulguration. The second, on the contrary, is nearly always the rule. From a practical point of view, these two kinds of death are distinguished, in this sense, that the first brings about definitive death, while the second may only consist in a state of apparent death, from which the person may be made to revive by practising artificial respiration immediately after the accident. A person struck by lightning should be treated exactly the same as one drowned, according to the formula given by M. D'Arsonval to electricians, the application of which formula has called back to life a number of men since its publication. As to electrocution, it is according to the opinion of MM. D'Arsonval and Biraud, a complicated, barbarous, and unreliable proceeding. M. D'Arsonval defies American doctors to practise artificial respiration after having electrocuted the criminal. Experience shows that an autopsy is a necessary aid in electrocution. Otherwise, he says, the use of dynamic electricity produces for the man a kind of anesthæsia, under cover of which he is mangled alive, and must be so in order to really become a corpse.

The Smoke Nuisance.—The City of London Electric Lighting Company, Limited, were summoned at the Southwark Police Court on Saturday last by Mr. Grist, sanitary inspector to the St. Saviour's Board of Works, for having on February 27th, and March 1st, 3rd, and 6th, sent forth black smoke from the chimneys at their station, Meredith's Wharf, Bankside, Southwark, in such quantities as to be a nuisance. Mr. Topham, solicitor, prosecuted; and the company were defended by counsel. One of the four summonses was taken as a test case. Evidence was given by engineers, experts, and others for the company to prove that theirs were the very best smoke-consuming furnaces; that only the best Welsh smokeless coal was used; and that the chimneys did not smoke. Inspector Grist and his assistant proved watching from 6 to 6.30 p.m. on February 27th, during which time dense volumes of black smoke were sent forth from the company's chimneys. Mr. Topham contended that the magistrate was bound by the case of "Weeks *v.* King" to convict, and that it was only necessary for him to prove that black smoke was sent forth, no matter how excellent the construction of the furnaces. Mr. Slade fined the company £5 and 2s. costs in the first case, and in each of the others inflicted penalties of 10s. and 2s. costs.

A Mass Meeting Approve of the Electric Light.—What is described by the local papers as a mass meeting of ratepayers was held the other evening at Limehouse Town Hall for the purpose of passing a resolution urging the Board of Works for the district to adopt electric lighting as speedily as possible. There was an almost unanimous opinion on the subject, and the resolution was about to be adopted when a working man rose to move an amendment on the grounds that the abolition of gas would do away with a good deal of labour. The amendment was lost, so was the working man.

Alternating Current Motors.—With the extension of the private supply in the City area, the motor problem will come into prominence in the case of basement offices. In this respect the small fan motors of the Excelsior Electric Company, nominally $\frac{1}{8}$th H.P., will become a help to the City company in filling up its day load curve, and it is to be noted that they are already considerably in evidence. At Prof. Fleming's Cantor Lectures one of these little sets was to be seen, and its excellent running attracted attention, while in many of the windows of electrical sundriesmen a sample is shown, sometimes in motion, but not always distinguished from its direct current neighbour.

Proposed New Pacific Cable.—A Reuter's telegram from Brisbane, dated 22nd inst., reads as follows:—"At to-day's sitting of the Intercolonial Postal Conference the Hon. J. G. Ward (New Zealand) moved the following resolution, seconded by the Hon. John Kidd (New South Wales): 'In the opinion of this conference, the time has arrived for establishing a second cable route *viâ* the Pacific to Vancouver, touching at such places as may hereafter be agreed upon.' In the course of the debate the Hon. Theodore Unmack (Postmaster-General of Queensland) stated that his colony had not entered into any agreement for the extension of the New Caledonia cable, but was free to support any fair proposal for the laying of the Pacific cable, independently of the Eastern Extension Company. The debate was subsequently adjourned."

The Sanction of a Local Board Dispensed With.—We admire any measure carried in the face of opposition. The Board of Trade have shown no hesitancy in carrying out the provisions of the Electric Light Acts, sometimes in the face of most strenuous antagonism. The Newmarket Local Board have always treated the electric light companies with little ceremony, and would never give their sanction to a provisional order. Happily the Board of Trade have resolved to dispense with the sanction of the Local Board. A decision such as this is a useful precedent, and will have a beneficial effect on vacillating local authorities.

Hampstead Lighting.—The Local Government Board have been graciously pleased to give their approval to the appropriation by the Vestry of a piece of land for the purpose of erecting a central station.

The Amenities of Electric Lighting Companies.—Electric light concerns had ever enemies ready and willing to do them an ill turn, but when they are subject to such inconveniencies as the Windsor electric light has recently experienced, they deserve the commiseration of all right thinking men. This electric light company was dependent on a direct supply of water from the water company. But without warning the water was cut off for several hours, and consequently the supply of light failed. We would advise central station authorities to lose no time in putting in storage tanks, for turncocks play strange pranks occasionally.

Portsmouth Electric Lighting.—In reference to our note of last week, we are informed that the electrical machinery now at the Town Hall will be perfectly unsuitable for the main station at Portsmouth; therefore, instead of its being removed to the station as we stated last week, it will be sold as soon as the central station is running.

Edgware Road to Victoria Electric Railway.—After an enquiry of four days, the Select Committee of the House of Commons, presided over by Sir John Kennaway, last Friday rejected the Edgware Road and Victoria Underground Electric Railway Scheme. This scheme has been strongly opposed, especially by the London County Council, the opposition being mainly directed to the injury the railway would do to Hyde Park Corner, where it was proposed to erect a station in the centre of the roadway, which a few years ago was widened and improved, partly by private subscriptions and partly by Government aid.

Lectures.—At a meeting of the North Stafford Mining Institute last Monday week at Stoke-on-Trent, Mr. W. M. Mordey delivered a lengthy address on the subject of electric lighting and transmission by power of electricity.

Birkdale Electric Lighting.—Last Tuesday's *London Gazette* contains a notice stating that the Board of Trade have revoked the Birkdale Electric Lighting Order, 1883.

Shoreditch Electric Lighting.—Under the heading of "Hackney Electric Lighting," last week, we stated that the vestry had decided to offer £28,000 for the purchase of the Pitfield Street site for an electric lighting station at Hackney. This should have been the Shoreditch Vestry, as the station referred to is for the Shoreditch district.

Mason College Engineering Society. — A general meeting of the above Society was held in Mason College on Wednesday, March 22nd. Mr. J. Watkins read a paper on "The Engineers' Slide Rule." The paper was followed by a discussion.

Polarisation.—In a voltaic cell consisting of platinum and amalgamated zinc plates immersed in dilute sulphuric acid (S.G. 1·11), and connected through a low resistance, polarisation takes place to nearly the same extent when the solution is kept boiling as when it is cold. On opening the circuit, polarisation disappears more rapidly with a boiling solution. The hot solution does not attack amalgamated zinc on open circuits.

Brighton Electric Light Company.—The Board of Trade have refused to grant a Provisional Order to the Brighton Electric Lighting Company. This decision is a most unfortunate one for the company, and it would not be unreasonable if they persisted in it being an unfair one. The Brighton Company have met with little consideration at the hands of the Corporation, and it must be clear by this time that the Electric Lighting Act of 1888 has been conceived with more regard to the municipal bodies than public companies.

The Failure of Gas in Bath.—Gas does not always enjoy that character for steadiness and sobriety with which its advocates seek to impress us, for we learn from a recent meeting of the Bath Town Council, when the gas account for street lighting was presented, that there had been many failures of gas, and on one occasion 536 lamps were out all night. There have been many complaints of electric light failures at Bath, but in view of the foregoing, one begins to feel a little more cheerful.

Diagonal Running of Telephone Lines.—The Technical Bureau of the Pressburg Telephone Service has recently introduced what is claimed to be a new method of running telephone wires. Instead of carrying the principal lines along the front or on the roof of the houses, the wires are run zig-zag fashion, that is to say, first on the right and then on the left-hand side of the street, no matter what may be the length of the span. For instance, the first may be 60 metres, the second 150 metres, and the third 80 metres. By this means it is said that fewer supports and insulators are required. This is shown by the statement that when formerly the Bureau used from 30 to 40 supports, it now only employs from 8 to 10. It is admitted that more wire is required by the adoption of this system, but it is contended that this is very insignificant when the great saving in supports and insulators is taken into consideration. Other advantages are also claimed for this system of running telephone wires.

The Proposed Elevated Railway in Berlin.—The scheme for the construction of an elevated electric railway in Berlin has come to a full stop. After the principles of it had been approved by the whole of the technical authorities, with the Minister of Public Works at their head, by the presidency of police and the magistracy, the scheme has been blocked by the Architectural Commission, under whose superintendence the Luther Church is being built. This commission, which had already addressed a protest to the Minister of Public Worship, has also sent a petition to the Emperor, urging that the construction of the projected railway would interfere with divine worship in that church. The scheme is now, it is said, blocked for another year.

Private Electric Lighting.—It is stated that Lyons Hall, Great Leighs, will shortly be lighted by electricity.

Lighting in Madrid.—The general meeting of the Madrid General Electricity Company approved the declaration of a dividend of 6½ per cent. per annum for 1892. The number of lamps installed increased from 13,000 in 1891 to 35,000 at the close of 1892.

Electric Lighting in the Isle of Wight.—There appear to be signs of an advance in the Isle of Wight, for at the meeting of the West Cowes Local Board, last week, a letter was read from the electric lighting company, stating that nearly half the capital had been promised, and that if the board would postpone adverse action for three or four weeks they would be able to set to work in earnest, and could start lighting by July 1st. It was resolved to defer any adverse action for one month.

Electric Traction in Berlin.—With a dividend of 12½ per cent. per annum for the ordinary shareholders, the directors of the now well-known Grosse Berliner Pferdebahn are not prepared to make any sacrifices which are demanded by the public, and by some of the holders of ordinary shares. They have, however, been in negotiation with the Berliner Electrizitats Werke, with a view to operating several electric tramcars experimentally, and the cars are to start running in the autumn.

The Electric Lighting of South Kensington.—The Unopposed Bill Committee of the House of Commons last Monday passed a Bill which confirms an agreement for the transfer to the Kensington and Knightsbridge Electric Lighting Company of so much of the undertaking of the Chelsea Electricity Supply Company as was authorised by the South Kensington Electric Supply Provisional Order, 1889.

Leyton Electric Lighting.—The Leyton Local Board have been advised by the Board of Trade to apply for a provisional order for electric lighting instead of simply a license.

Overhead Wires at Middlesbrough.—At a recent meeting of the Streets Committee of the Midlesbrough Corporation an application was considered from Mr. T. W. Scarlett, proprietor of the Wellington Hotel, Albert Road, and the Newmarket Hotel, Corporation Road, to carry an electric wire over Albert Road and along Albert Mews, from the Wellington Hotel to the Newmarket Hotel, which he proposed to light by electricity from a dynamo in the former building. Councillor Burrows said that if this privilege was granted others might apply for it and that they might have their streets covered with such wires. The chairman thought that they had too many wires overhead already, and if permission was granted in the present case he thought wires should be carried underground. The advice of an electrician is to be obtained on the matter.

Hanley Electric Lighting.—At a meeting of the General Purposes Committee, a letter was read from the Board of Trade provisionally approving of the system for the supply of electrical energy for the purposes of the Hanley Electric Lighting Order, 1891, subject to the regulations and conditions for securing the safety of the public, and for ensuring a proper and sufficient supply of energy which they imposed upon the undertakers under the said order. The committee recommended that the tender of Mr. C. Cornes for the erection of the buildings and chimney shafts at the electricity works be accepted.

The Daily Press and Mis-statements.—Whenever any one of the great and enlightened press of England stoops to record electric lighting matters, it is usually done in an unique manner. The *Leeds Mercury* a few days ago stated, on good authority, of course, that the Hull Corporation would have to pay the Westinghouse Company £300 for using the three-wire system. The facts are, that the Electric Lighting Committee have decided to pay the royalty asked for, which is £2 10s. per annum per ton of copper laid. About 22 tons of copper have been laid, and the annual royalty on account of it will therefore be £55. The *total* amount of royalty that will have been paid at the termination of the unexpired term of the patent will amount to about £220, so it is difficult to appreciate the good authority of the *Leeds Mercury*.

Telephony and Telegraphy in France.—A telephonic line passing through Bordeaux will soon be established between Toulouse and Paris; it has just been decided upon. The Minister of Commerce has authorised the establishment of telegraph offices in the communes of Arthez-Asson (Basses Pyrénées), Grandes-Côtes (Marne), St. Malo (Ille-et-Vilaine), Sainville (Eure-et-Loir), Baudreville (Eure-et-Loir), Montferrier and Vendémian (Hérault), Longraye (Calvados), Imphy (Nièvre), and Polliat and Vounas (Ain).

Telephone Trunk Lines.—The Postal Telegraph Department's trunk line to Brighton is completed but for a few finishing touches. It will be open to the public early in April. It is built of heavy copper wire, and runs along the London, Brighton and South Coast Railway to Brighton station. The underground connections at London and Brighton consist of dry core cables of low capacity, the copper conductors having a weight of 150 lbs. to the mile. The two wires forming the metallic loop are twisted throughout their entire length. The Department's cable ship *Monarch* starts on Good Friday with a 4-wire cable to be laid across the North Channel from Port Patrick to Donaghadee. This cable will complete the trunk line between Belfast and Glasgow, the land lines on both sides being already erected. With fair weather the cable will be laid early next week, and probably the great Irish and Scotch industrial centres will have telephonic connection by the end of the week. The land lines are of 800 lbs. copper wire, and the cable has been made in a similar manner to the Paris telephone cable, laid between St. Margaret's Bay and Sangatte. It has been constructed by Messrs. Siemens Brothers & Co.

Electrical Tables and Memoranda.—Messrs. E. and F. N. Spon have now ready a capitally compiled work, in waistcoat-pocket size (2½ inch by 1¾ inch), bound in French morocco, gilt edges, with numerous illustrations, price one shilling. The authors are Dr. Silvanus P. Thompson and Mr. Eustace Thomas, and we can cordially recommend the book as a real waistcoat-pocket volume, the contents embracing over 200 subjects.

NEW COMPANIES REGISTERED.

Australasian Incandescent Gas Light Company, Limited (38,399).—This company was registered on the 14th inst., with a capital of £35,000 in £1 shares, to carry on in different parts of the world, and especially in Australasia and New Zealand, the business of manufacturers of and dealers in incandescent gaslights, fittings, accessories, and other gaslights; also the trades of electrical, mechanical, and chemical engineers, builders, and contractors. The subscribers (with one share each) are: A. Cohen, 2, Bury Street, E.C., merchant; E. Cohen, 2, Bury Street, E.C., merchant; J. F. Lea, 32, Alkham Road, N., clerk; A. S. Edwards, Bickley, clerk; A. F. Gardner, 69, Turner's Road, Bow, clerk; F. T. Bickford, 4, Fenchurch Avenue, E.C., solicitor; J. Renwick, Stamford Hill, clerk. The number of directors is not to be less than two nor more than five; qualification £250; remuneration £500 per annum. Registered office 2, Bury Street, St. Mary Axe, E.C.

English Electric Carbon Company, Limited (38,434).—This company was registered on the 18th inst. with a capital of £10,000 in £10 shares; to erect and establish works for the manufacture of electric light and other carbons at the Smelt, near Brymbo, Denbigh, and to carry on there the business of electric light manufacturers. The subscribers (with one share each) are: J. H. Darby, Pen-y-Garth, Brymbo, ironmaster; Wm. Williams, Glasfryn, Caerwyd, timber merchant; F. Lynch, Wrexham, gentleman; Wm. Darby, Birmingham, iron merchant; A. Darby, Wrexham, secretary; T. A. Acton, Wrexham, solicitor; T. G. Littleboy, Wrexham, electrical engineer. The rules of Table "A" generally apply. Registered office, The Smelt, Brymbo, Denbigh.

Pneumatic Patent Company, Limited (38,433).—This company was registered on the 17th inst., every member becoming liable for a sum of £1 in case of liquidation, to purchase, use, work, and exploit any patents, of any nature whatsoever, and to carry on the business of machine and other manufacturers, electricians, mechanical engineers, suppliers of electric, steam, pneumatic, or other forces, for the purposes of light, heat, and motive power. The subscribers are:—C. C. Macrae, 26, Cheyne Walk, Chelsea, S.W., barrister-at-law; H. Evan Thomas, 10, Bina Gardens, S.W., barrister-at-law; A. McNutt Wier, Kingston-on-Thames, retired shipowner; M. A. Win, Kingston-on-Thames, engineer; F. E. D. Acland, C.E., 22, Cheyne Gardens, S.W.; E. L. E. Thomas, Billiter Street, E.C., merchant; H. S. Stevenson, 31, Lombard Street, E.C., solicitor. The rules of Table "A" generally apply. Registered office, Dock House, Billiter Street, E.C.

Otis Elevator Company, Limited (38,450).—This company was registered on the 20th inst., with a capital of £50,000, in £10 shares, to adopt and carry into effect an agreement dated March 13th, 1893, made between the American Elevator Company and J. C. Bull, for the sale of the goodwill of the business of manufacturers and dealers in hydraulic, electrical, and steam elevators and other machinery carried on by the American Elevator Company in Europe, Asia, and Africa, all inventions and other patent rights owned by this company; an agreement made between Otis Brothers and the company and J. C. Bull on behalf of the company with reference to improvements in these inventions, and also an agreement made between the Brush Electrical Engineering Company, Limited, and J. C. Bull relating to the manufacture of elevators and other machinery, and to carry on the business of manufacturers and dealers in hydraulic, electric, and steam elevator lifts and other machinery. The subscribers (with one share each) are: N. S. Russell, C.E., 39, Coleman Street, E.C.; W. C. Mann, Stoke Newington, accountant; H. E. Arnold, 49, Queen Victoria Street, clerk; B. Broadhurst, Surbiton, secretary; H. Sullivan, 1, Queen's Mansions, S.W., engineer; J. M. Lachlan, 2, Achilles Road, N.W., engineer; C. F. Rowsell, Finchley, N., solicitor. The first directors (whose number is not to be more than six nor less than three) are to be W. A. Gibson, N. S. Russell, E. Woods, H. Sherley-Price, and R. H. Thorpe. Qualification £250. Remuneration £100 per annum each. Registered by Ingle, Cooper and Holmes, 20, Threadneedle Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

The National Company for the Distribution of Electricity by Secondary Generators, Limited.—The annual return of this company has been filed and shows that out of a nominal capital of £500,000, in 3,000 preference and 47,000 ordinary shares of £10 each, 2,669 preference and 20,000 ordinary shares have been taken up with £10 called on each. The total amount of calls received reaches £17,690, and that agreed to be considered as paid on 21,000 shares—1,000 preference and 20,000 ordinary—£210,000. The amount paid on 100 forfeited shares is £1,000.

Chatham, Rochester and District Electric Lighting Company, Limited.—The annual return of this company has been filed, and shows that out of a nominal capital of £50,000, in £5 shares, 3,690 have been taken up, of which 1,663 have been issued as fully-paid. The full amount has been called upon 2,000 of the remaining shares, and 27 others have had £1 per share called on them. The calls paid reach a sum of £10,025, and there is £2 unpaid.

Kensington and Knightsbridge Electric Lighting Company, Limited.—The annual return of this company has been made up to the 2nd inst. and shows that out of a capital of £350,000, in 50,000 ordinary and 10,000 first preference and 10,000 second preference shares all of £5 each. 15,000 ordinary and 10,000 first preference shares have been taken up, and the full amount called. The calls paid reach the sum of £100,000 and shares to the value of £25,000 have been issued as fully paid.

Weybridge Electric Supply Company, Limited.—The annual return of this company made up to January 12th last, shows that only 7 shares have been taken up out of a capital of £15,000 in £5 shares. No calls have been made.

Mountain's Wire Manufacturing Company, Limited.—Mr. Justice Vaughan Williams has ordered that this company be wound up.

Newcastle and District Electric Lighting Company, Limited.—The annual return of this company made up to February 27th ult., has been filed at Somerset House and shows that out of a nominal capital of £50,000 in £10 shares, 3,535 shares have been taken up and a call of £8 per share made. The calls paid amount to £28,040 leaving £240 in arrears.

United Electric Sewage and Chemical Syndicate, Limited.—The statutory return of this company has been filed and shows that out of a nominal capital of £5,000, in £1 shares, 4,757 have been taken up. There have been 4,750 of these issued as fully paid, £7 being paid on the remaining shares.

Wolverhampton Electric Light Company, Limited.—The annual return of this company made up to February 15th 1893, shows that the 23 original signatories are the only shareholders. There has been £10 paid on each of these shares. The nominal capital of the company is £50,000.

St. Luke, Chelsea, Electric Lighting Company, Limited (late New Cadogan and Belgrave Electric Supply Company, Limited).—The statutory return of this company made up to January 11th last, shows that out of a nominal capital of £30,000 only 7 shares have been taken up. Nothing has been paid.

Ogmore Valley Electric Light and Power Supply Company, Limited.—The annual return of this company was filed on the 9th of last December and shows that out of a capital of £10,000 in £5 shares, 619 have been taken up. There has been £4 called up on 599 shares and £1 on the remaining 20. The amount of calls received is £2,161. There is £255 unpaid.

Cuba Submarine Telegraph Company, Limited.—The annual return of this company, made on the 8th inst., has been filed, and shows that the whole of the capital of £220,000 (which is divided into 16,000 ordinary and 6,000 preference, all of £10 each) has been taken up. The full amounts have been called and paid.

Galloways, Limited.—The annual return of this company, made up to the third of this month, shows that out of a capital of £250,000 in £100 shares, 2,108 have been taken up. The full amounts have been called on these, and £210,800 has been paid.

Shippey Brothers, Limited.—The annual return of this company has lately been made, and shows that 2,412 shares have been taken up out of a capital of £30,000 in £5 shares. There were 1,800 of these issued as fully paid. The full amounts have been called on the remainder, and the amount realised reaches £3,060.

Taunton Electric Lighting Company, Limited.—The annual return of this company was made on 20th inst., and shows that out of a nominal capital of £20,000, in 4,000 shares of £5 each, 2,569 have been taken up. There has been £5 called on each of 1,782 shares, and the total amount of calls received is £8,910. The sum agreed to be considered as paid on 789 shares reaches £3,935.

Wrexham and District Electric Supply Company, Limited.—The annual return of this company has been filed at Somerset House, and shows that out of a capital of £10,000, in £5 shares, 115 shares have been taken up; but nothing has yet been called on these.

Collier-Marr Telephone and Electrical Manufacturing Company, Limited.—The statutory return of this company has been made up to the 23rd of last December, and lately filed at Somerset House. It shows that out of a nominal capital of £100,000, in £10 shares, 1,015 have been taken up. A call of £7 10s. has been made, and the payment resulting from this is £5,110. There is £2,552 10s. in arrears.

National Electric Supply Company, Limited.—The annual return of this company made up to the 3rd inst., shows that out of a nominal capital of £100,000, in 100 founders' and 19,900 ordinary shares all of £5 each. All the founders' and 10,465 ordinary shares have been taken up with the full amount called on each. The total amount of calls received is £52,810, and there is still £15 unpaid.

Woolwich District Electric Light Company, Limited.—The annual return of this company, made up to February 25th last, shows that out of a capital of £10,000 in £1 shares, 3,435 have been taken up. There have been 150 shares issued as fully paid, and the full amounts called upon 265 shares. A sum of 7s. 6d. per share has been called upon 2,900 shares, 10s. per share on 25 shares, and 5s. per share upon 75 shares. No calls have yet been made on the remaining 20 shares. The total amount of calls is £1,383 15s.

Wenham Company, Limited.—The annual return of this company, made up to December 30th last, has just been filed. When the company was registered in May, 1888, the capital was £250,000 in £1 shares; but in 1889 it was resolved to reduce this to £83,333 6s. 8d. in 250,000 shares of 6s. 8d. each. There are 178,954 shares taken up, the whole of which except seven taken by the subscribers to the memorandum of association, were issued as fully paid.

Electricity Supply Corporation, Limited.—The annual return of this corporation, made up to April 27th, 1892, has only just been filed. It discloses the fact that at the time of making up, 718 shares, out of a total of 30,000, each of the value of £5, have been taken. All calls to the extent of £3,590 have been paid. A public issue of capital was, however, made after the date these returns were computed, and according to the estimations made on the 3rd inst. (filed at the same time as the above), 16,566 shares have been taken up. The full amount has been called, and £82,780 paid in respect thereof.

Windsor and Eton Electric Light Company, Limited.—The registered office of this company is now situated at Acre House, Bachelor's Acre, Windsor, Berks.

CONTRACTS OPEN AND CLOSED.

OPEN.

Szedegin—September 1st. Tenders are invited for lighting this town, either by gas or electricity. Tenders will be received up to September 1st. Particulars may be obtained of the Municipal Engineer.

CLOSED.

Derry.—The following tenders have been accepted:—Siemens Bros. & Co., for dynamos, arc lamps, and conductors, £8,905; A. Brown & Sons, for engines and boilers, £4,293; C. M'Clelland, for buildings, £985; M. M'Clelland, for purchase of site, £600; opening and closing streets, £300; engineers' fees, £700—£15,793.

BUSINESS NOTICES, &c.

Electric Light in Ireland.—The electric light is gradually making its way into the most remote districts in Ireland. In the County Donegal, in the extreme north, an installation is being put down at the residence of Mr. J. Watt, of Claragh. It is intended to use an oil engine of the "Hornsby-Akroyd" type to work direct on to a Norwich compound dynamo. A set of accumulators of the E.P.S. type are included, and these are so controlled by an ingeniously devised switching arrangement, as to enable one half the battery to be charged at the same time that the lamps are alight. By this arrangement it will not be necessary to work the engine specially for charging the accumulators, and thus there will be a considerable saving in fuel, as the engine while running will always be fully loaded, and there is therefore no waste of power. The installation is being carried out by Messrs. Laurence Scott & Co., of Norwich, to the specification and under the superintendence of Mr. Angelo Fahie, M.I.E.E., consulting electrical engineer, of Dublin.

Steamboat Lighting.—The passenger saloon steamboats *Monarch* and *Victoria*, of Messrs. Cosens & Co., Limited, Weymouth, have just been fitted throughout with the electric light by Mr. F. M. Newton, electrical engineer, Taunton, under the superintendence of his electrician Mr. E. Poole, and it has proved highly successful. The *Monarch* has been fitted with electro-plated fittings for the 60 Edison-Swan incandescent lamps of 16 C.P., and a mast-head arc light of 2,000 C.P. The Taunton steam dynamo coupled direct to a silent running high-speed Robey engine at 25 lbs. steam, at 350 revolutions per minute, supplies the current at 60 volts. The *Victoria's* installation consists of 36 16-C.P. lamps and 8 C.P. lamps, and a Newton arc lamp of 2,000 C.P. The steam dynamo geared by friction wheels to a Hindley engine at 25 lbs. steam, supplies the current at 60 volts; the lamps are all under control from the switchboard which is fixed in the engine room.

Catalogues.—The General Electric Company, Limited, have just issued a catalogue of electrical apparatus for medical purposes. The compilers have succeeded in collating a large variety of electro-medical appliances, which are very well illustrated as well as being generally described and priced. The following are some of the headings in the book:—Faradisation, under which heading medical coils and cells are detailed; magneto-electro-medical machines; galvanisation, under which are described constant-current batteries, switchboard for using the current obtained from a central station for galvanisation, electrolysis and faradisation; electrodes, &c., of which there are a large number; electrodes for electrolysis; galvano cautery; electric light by batteries; E.C.C. dry form; Leclanché batteries; bichromate batteries, Edison-Lalande batteries; testing instruments; double collectors and a number of other electrical articles. This catalogue is a very good one and well worth perusal by our readers, whom we recommend to apply for a copy from the General Electric Company at 71, Queen Victoria Street, E.C. It is perhaps worth noting that the company only manufacture appliances essentially electrical in their nature.

Messrs. Crompton & Co., Limited, have sent us a copy of their advance price list of arc lamps, accessories, and sundries. The list is dated March, 1893, and consists of 8 pages. It is very nicely printed.

The Edison & Swan United Electric Light Company, Limited, have forwarded us copies of their Sections 1, 2 and 3 price lists. The books are well got up, and will be very handy to all purchasers of incandescent lamps of whatever shape, installation fittings and accessories, or measuring instruments. Section 1 deals solely with incandescent lamps, and comprises much useful data for users of same. Section 2 contains particulars of all sorts of electrical fittings and apparatus, *i.e.*, lampholders, switchboards, terminals, cut-outs, &c., &c. Section 3 describes gravity ammeters and voltmeters, Cardew voltmeters, engine room Cardew voltmeters, cell testers, Edison meters, Fleming & Gimingham voltmeter and resistance coils. Each of the three catalogues are fully illustrated with a large number of clear cuts.

A new catalogue has lately been published by the Electrical Power Storage Company, Limited. This is a revised price list which shows that the company are considerably reducing their prices on and after the 3rd proximo. The reductions, it appears, vary from about 15 to 20 per cent. on the different classes of goods. The book—which is thoroughly well printed and bound, and neatly set out—deals with E.P.S. batteries of the many various types, central station cells. Several pages are devoted to the following headings:—Supply of acid; renewals; exchanges; special separators; sundries; hydrometers; E.P.S. cell tester; automatic apparatus; portable hand. lamp. The book is well worth perusal, and we can confidently recommend it as worthy of our readers' attention.

The Belgian Electric Lamp Manufacturing Company have sent us a copy of their 8th annual price list, which is a small folding card. Prices and other details are given of carbons for arc lamps and a table for ascertaining prices per yard or per mile of wire.

Woodhouse & Rawson.—In the Lord Chief Justice's Court on Wednesday last week, the first case on the list as a non-jury action was Woodhouse & Rawson, Limited *v.* Judd, Lindsay & Co. Upon the case being called on, there was no appearance on either side, and the case was struck out.

A notice in the *London Gazette* states that a petition for the winding up of the above company by the High Court of Justice, was, on the 16th day of March, 1893, presented to the said Court by the Rate and Tax Payers' Assessment Protection Association, Limited, of 10, Serjeants' Inn, Fleet Street, creditors of the said company; and that the said petition is directed to be heard before the Court sitting at the Royal Courts of Justice, Strand, on April 11th.

The "Monarch" Dry Battery.—Under this designation Messrs. W. H. Baughan & Co., of Charlbury, are producing a dry battery which they assert is the cheapest dry cell in the market. It can be kept in stock any length of time without loss of strength.

General Electric Power and Traction Company.—The Council of the Royal United Service Institution have instructed the General Electric Power and Traction Company, Limited, to put in an electric lighting plant in the old Chapel Royal, in Whitehall, which is being altered for the new Museum.

The New York Engineering and Mining Journal.—We are informed that the proprietors of this paper have opened a London office at 20, Bucklersbury, E.C. (representative Mr. Edward Walker), where business relating to the editorial, sales, and advertisement departments will be attended to.

Infirmary Electric Lighting.—Messrs. Gent & Co., Leicester, have secured the contract for fitting the Holborn Union Infirmary with 20 sets of their "Combination" telephones, also a 20-station central indicator and switchboard, using the existing bell wires for the telephone circuits.

A New Publication.—We have received a copy of No. 1 of the *New South Wales Railway Budget*, which purports to be an organ devoted to the interests of the railway and tramway services, and is conducted by the Sydney Railway Institute Council.

Electric Lighting of Ironworks.—Messrs. R. D. Smellie and Co., electrical engineers, Glasgow, have just completed a second set of their special arc lighting plant for the steel and ironworks of David Colville & Sons, Motherwell.

Personal.—Mr. Edwin J. Reid, of Messrs. Reid Bros., electrical engineers and contractors, of Wharf Road, N., has been elected a member of the Institution of Electrical Engineers.

The Electrical Supplies and Fittings Company, Limited.—At the extraordinary general meeting of this company held on 20th inst., the following resolutions were passed, viz.:—(1.) That it has been proved to the satisfaction of this meeting that the company cannot, by reason of its liabilities, continue its business, and that it is advisable to wind up the same, and accordingly that the company be wound up voluntarily. (2.) That Mr. James Scott, of 8 and 10, Charing Cross Road, London, W.C., be, and is hereby appointed liquidator for the purposes of such winding up.

Electrical Engineering Appointments.—Mr. James Dempster, a former day and evening student of the Glasgow and West of Scotland Technical College, has just been selected from a number of competitors for a three years' engagement in Ceylon by a firm of engineers who are supplying electric lighting and power plant to different estates. Mr. Andrew Pinkerton, one of the best students in Prof. Jamieson's electrical engineering classes, has just been engaged by the firm of Messrs. Siemens Bros. & Co. as a draughtsman in the dynamo department of their Woolwich works.

Russell & Co.—This firm inform us that they have lately fitted up for electric light and wired a number of different premises, amongst which may be mentioned a residential flat at No. 45, Albert Gate, a large mansion at No. 56, Holland Park, a private house at No. 9, Coburg Place, and a bicycle works at Walham Green. The marine and loco boilers, and the vertical compound steam engine, of which they make a specialty, are also finding favour with the trade.

Electric Lighting of Manchester Free Trade Hall.—Messrs. B. Verity & Sons, of London and 29, Princess Street, Manchester, have secured the contract for the whole of the wiring and fittings for the Free Trade Hall, Manchester, which will be one of the largest installations next to the Town Hall, to be supplied from the Corporation's new central station, which is now nearing completion.

The "Premier" Gas Engine.—Messrs. Wells Bros., of Sandiacre, have issued a new price list of their gas engines, including those specially made for electric lighting, fitted with two heavy fly-wheels and sensitive governor. The speed variation from full load to no load in these engines is less than two per cent. and the gas consumption per 60 watt lamp 2 to 2½ cubic feet per hour.

Jamaica Electric Lighting.—We have received from the Jamaica Electric Light and Power Company, Limited, of Kingston, Ja., a reprint of an article on the history of electric lighting in Jamaica, from the *Gleaner*. In this article are set forth at considerable length all the difficulties that have been placed in the way of the company to prevent electric lighting progress in Jamaica.

The Electric Supplies and Fittings Company, Limited.—Creditors of the above-named company are required, on or before the 25th day of April, 1893, to send their names and addresses, and the particulars of their debts or claims, and the names and addresses of their solicitors (if any), to John Scott, the liquidator of the said company, at 8 and 10, Charing Cross Road, London, W.C.

Schuckert & Co.—A telegram from Frankfort states that the Schuckert electricity establishments at Nuremberg, are to be handed over to a limited company, with a capital of 12,000,000 marks, to be formed for this purpose. Frankfort, Cologne, and Hamburg bankers, it is said, are assisting in forming the company.

Change of Address.—Messrs. Wake & Sanders, late of Fowkes Buildings, E.C., announce that their address in future will be 3, Crosby Square, London, E.C.

CITY NOTES.

Notting Hill Electric Lighting Company, Limited.

THE sixth ordinary general meeting of this company was held at the Central Station, Bulmer Place, High Street, Notting Hill Gate, on Monday last, Professor Wm. Crookes, F.R.S., presiding.

The SECRETARY (Mr. W. H. Fox) having read the notice convening the meeting, the report and accounts were taken as read.

The CHAIRMAN on moving the adoption of the report and accounts, said: You will doubtless think it unnecessary for me to refer to any great extent to the accounts as they are published in such full detail that I think they speak for themselves. There are one or two points, however, which perhaps you feel interested in having a little information upon, and I therefore devote a few minutes to these matters. In Table No. 4 there are one or two items on the debtor side to which I must draw attention; the first is the cost of hiring temporary boilers £16 17s. 6d. and to this may be added a further sum of £18 12s. 6d. for wages and stores in connection with the same, making a total of £35 10s., which will not appear in the accounts of this year as the boilers have been dispensed with, our load now being sufficiently good to render continued use of the large boilers economical. Another item to which I would refer is rents payable £161 10s., which, as stated in the report at the foot of the revenue account, includes a sum of £100 for rent of special local office at 105, High Street, which has been given up, as it was not considered advisable in the interests of the company to take a further lease of the premises; as a matter of fact the directors had previously endeavoured to rent the house, but could not do so at a reasonable rate, there will therefore be a saving of £135 10s. in the accounts for this year from these two

sources, and we also do not expect that the law expenses will be anything like so large as those appearing in the accounts before you. As you will see by the credit side of the accounts, No. 4, the amount of revenue from the sale of current for the year was £2,518 17s. 1d., which shows a very satisfactory increase over the £999 10s. 6d. earned during the previous seven months. The bad debts for the year amount to only £5 10s. 2d., which, I think, reflects credit on the management in the choice of customers, and in requiring guarantees in doubtful cases. Perhaps a little explanation is needed with regard to the fee of £250 from the New Telephone Company, Limited, which appears in the revenue account. The fee was paid by them to this company merely for entering into an agreement whereby, amongst other things, the company agrees to allow the Telephone Company to lay wires in our culverts for telephone purposes at a certain rental per mile of wire, the minimum rental being fixed at £100 per annum; and the provisions of the agreement take effect upon the granting of the necessary approval by the Board of Trade, which, I believe, has not yet been obtained. On the debit side of the accounts appears an item of £92 16s. 10d. for interest on loans, and we do not anticipate any similar liability being incurred this year, as the charge is for interest payable to the directors in connection with the construction of the Phillimore district mains, to which I shall refer again presently. The debit balance of £617 5s. 7d., which appeared in the net revenue account at the end of the previous year has been reduced to £347 16s. 4d., but this is chiefly through the amount of £250 of directors' fees being re-credited in the account, and perhaps a little further explanation would not be out of place here with regard to directors' fees. As you are aware the total amount payable to the directors under the company's articles of association is £1,000 a year, and as stated in the last report, the directors did not draw their fees for the quarter ending December 31st, 1891, and have not drawn any since that time, therefore at December 31st last the total amount of fees due to the directors was £1,250. In view, however, of the present position of the company, the directors have agreed to return to the company half of the fees due, and have also agreed to accept only half fees for the present year, and they have gone further and agreed to postpone their claim to the half fees due, together with those due for this year, until the accounts have been presented in 1894. An agreement embodying this arrangement has been prepared and signed by all the directors, and I am sure you will all agree with me that the directors have acted in a most generous manner with regard to this. As regards the depreciation fund account No. 7, you will notice the directors have not thought it necessary to provide for depreciation, as they are advised that the charges in the revenue account, under the head of repairs and maintenance, are sufficient for the purpose, and I would add that the mains and machinery are kept in such a thorough state of efficiency, that it does not appear to the board necessary to make any special provision for this at present. The last account is a statement of electricity generated, sold, &c. Quantity generated in B.T. units, 95,509; quantity sold—private consumers by meter, 75,667, total sold 75,667; quantity used on works, 4,452; total quantity accounted for, 80,119; quantity not accounted for, including loss in distribution—absorbed by batteries, 13,061, lost in mains, 2,268; total maximum supply demanded, 9,438 8-C.P. lamps. The only figure requiring any special explanation in this statement of figures is the quantity not accounted for. Of the 13,061 units said to be absorbed by the batteries, I think it might be fair to charge the batteries with only 9,000 units, the balance being debited to losses in meters, and the difference between the current at 101 volts we actually give consumers, and the current at 100 volts that we charge to them. The 2,268 units lost in the mains represents the amount of energy expended in overcoming the resistance of the mains. The actual quantity not accounted for is therefore only 61 units, and I do not think any other company in London can show you such a satisfactory result. During the year we have made several extensions of the mains; but by far the principal one was the extension to the Phillimore district, and it was with the special object in view of making these extensions, that the ordinary preference shares were issued; but before deciding to extend to this part of the area, the directors took great care to ascertain the amount of support likely to be received in the neighbourhood, and on finding that there was every likelihood of obtaining a satisfactory return on the capital outlay, it was decided to carry out the work, and the directors are pleased to find that their estimate was correct, as we have already a good number of houses connected on the extension. It was thought at one time that it would be necessary to have a battery station to supply this district, but I am glad it has been found possible to acquire the current required without the aid of this, and we therefore saved a large capital outlay in that direction. Since the end of last year the company has made a further extension to Observatory Gardens and Observatory Avenue. But in this instance, as in the case of several small extensions carried out last year, the directors have obtained advances from those interested, to bear cost of the work done, to be repaid by not charging the consumers on the extension for any current consumed until the loan had been paid off, and we find that this plan acts very well. The item of £485 5s. 7d, in account No. 8, debtor side, shows deposits made at such cases to cover the guarantees. These are only repayable by our not charging the consumers of current until the loan is paid off, so you see the company does not run any risk with these minor extensions. The guarantees vary in accordance with the necessity of the cases, and several have already run off. I think these few cases ran only once in which there are no charges of the company. The cost of the Phillimore extension has been £6,500; the number of houses in the extension already wired and lighted is 17, and the number of lamps reduced to a uniform 16-candle unit, 1,351. The estimated revenue from these extensions is £500 in the current year and £600 in 1894. As you are aware, the directors obtained the sanction of the shareholders in May last to issue the balance of the ordinary shares, amounting to £29,080, in the form of ordinary preference shares bearing cumulative dividend of 6 per cent. These shares were in the first place offered to the shareholders of the company in proportion to their holdings, and up to December 31st 796 shares were taken up, representing £7,960, and since that date the directors have allotted 20 in addition. I think, practically, the whole of the capital received from the issue of these shares has been spent in making extensions of the mains and in the purchase of additional machinery required owing to the increased area of supply. No money is now owing to Messrs. Crompton & Co., Limited, the contractors for construction, though an arrangement was made that money could have been borrowed in the event of the preference issue having not been successful. Our property, with the trifling exception of the extensions made is quite free, being saddled with no mortgages, no debentures, and no charges. When I had the pleasure of addressing you at the general meeting last year, we had 77 houses connected to the mains, representing 6,056 8-C.P. lamps, which, by the end of December last, had been increased to 124 houses, representing 9,438 8-C.P. lamps, or an increase of 47 houses and 3,382 lamps, and I am very pleased to be able to say that, so far as the present year has gone, the increase in the number of houses in proportion to the whole of last year has been slightly larger, so that if the state of increase goes on, as we have every reason to expect will be the case, we may expect to be very shortly in an extremely sound position, and yielding to the shareholders a substantial return on their investments. The present number of lamps on our mains is 9854, bringing in an estimated revenue of about £3,500 per annum; by the end of 1893 we may reasonably expect the increase of lamps to be such as to raise the yearly revenue to about £4,000. I am pleased to say that during the year the mains and machinery have done their work in a most efficient and satisfactory manner, and with the exception of three instances during the winter, when some of the mains were flooded owing to the bursting of the water mains, no accident of any kind has occurred. In each case the flooding of the culverts happened in frosty weather, and the escaping water undermined that particular part of the roadway, and filled the culvert with water, consequently making an action between the strip and causing a loss of 240 units. In the places, however, where these accidents happened the directors have thought it advisable to specially drain the culverts, and they are also making representations to the London County Council with a view to preventing a recurrence of the nuisance, as the real cause of the trouble is the blowing out of the fireplugs which are old-fashioned ones and ought to be replaced by something of modern type. There was only one other thing which occurred during the year to trouble us, and that was a considerable leakage of water into the basement of the central station, which was likely to damage the foundations. It took a considerable time to ascertain the source from which this came. It was at last discovered and the leakage stopped. We have, I regret, not quite reached our expectations in regard to the yield per lamp per annum. The actual revenue was only 7s. per lamp instead of 10s., as was hoped at the last meeting. It was difficult to account for that difference; possibly it was owing to Notting Hill being higher than the surrounding districts, and less affected by foggy weather. After some further remarks regarding a scale of rebates instituted by the company, and a few words regarding the three-wire system, he formally moved the adoption of the report and accounts.

The resolution was seconded by Mr. SIDNEY WATERS, and carried unanimously.

The retiring directors, Prof. Crookes and Mr. Waters, were re-elected, as were also the auditors, Messrs. Deloitte, Dever, Griffiths and Co., at a reduced remuneration of 15 guineas.

The meeting closed with a vote of thanks to the chairman and directors.

Direct Spanish Telegraph Company, Limited.

THE thirty-ninth ordinary general (half-yearly) meeting of the above company was held on Friday last, March 24th, at Winchester House, E.C., Mr. Edmund Etlinger presiding in the absence of Sir James Anderson (chairman) through illness.

The SECRETARY (Mr. Ch. Gerhardi) read the notice convening the meeting, also the minutes of the previous meeting.

The CHAIRMAN, in moving the adoption of the report and accounts, said that the half-year under review (ending December 31st, 1892) had been very uneventful. Their traffic receipts had shown a very slight increase, and on the other hand their expenses had been very much the same as they were before. Considering that trade and commerce all over the world had not been brisk, but rather slack, and also considering that there had been no political event which would throw extra work on Spanish and International wires, he thought they might be satisfied with the results they had obtained, that result being that they were now better off by £410 this half-year than they were a year ago for the corresponding half-year of 1891. They could also congratulate themselves upon the fact that during the half-year there had been no occasion to expend any money in cable repairs, none whatever, and the small works they had to carry on in connection with the land lines at Bilbao and Barcelona, had been completed with the small expenditure of £171, charged against revenue. Turning to the balance-sheet, they would see that they had expended nothing on capital account; they had raised no additional capital and they had contracted no loan; the debentures remained exactly as they were before; but, as they were told at the last meeting, those debentures fall due in May, 1894; that fact, he thought, need cause them no anxiety whatever; they would, by that time, have a reserve fund of £40,000, they had a yearly net income of £14,000, and they had uncalled-up capital of £13,000. Under those conditions there could be no difficulty whatever, when the time came, of arranging about those debentures. There was no occasion for him to go into that matter at all now. As to the reserve

fund, it stood at the end of 1892 at £30,331 odd, at this time last year it stood at £23,946. They therefore had increased their reserve fund during the twelve months by £6,386. That, they must confess, was satisfactory. Regarding the outstanding liabilities, they stood at £12,688, which sum represented the balances in account with other telegraph administrators due by the Direct Spanish Company at December 31st, 1892, and those were counterbalanced by the amount due to them from foreign administrators amounting to £18,000. He need hardly say that since December 31st both these amounts had been very much reduced. Then there was the profit and loss account, which stood at £5,438 19s. 7d. for the half-year. That amount left their profit for the half-year less the debenture charges, and it was really the amount which they had now to deal with. Reference to the revenue account would show that their expenditure had been, in 1892—the second half—£4,892 4s. 2d.; the expenditure for the corresponding period in 1891 was £5,381 0s. 7d., therefore their expenditure had been less by £398 16s. 5d., and if they added to that that their total receipts had increased by the very small amount of £11 10s. 3d., then they would find that the total result of the half-year's working was that they had increased their receipts by £410 6s. 8d. That was not much; but as he said before, it was not unsatisfactory under the circumstances. Then the balance of profit for this half-year was £7,252 9s. 7d.; last year it was only £6,842 2s. 11d., and that of course was the exact difference he stated before of £410 6s. 8d. He next referred to the appropriation account; that was the statement as to how the £5,438 19s. 7d. should be dealt with. In the first place they took, as per arrangement, £2,500 for the reserve fund; secondly, they took, also for the reserve fund, the sum of £442, that being on account of the repayment of a certain amount which they borrowed from the reserve fund in 1891 for cable repairing purposes; the total then repaid will be £883, leaving £1,393 to be repaid out of future half-years. Then they recommended the shareholders to declare dividends, namely, the preference dividend at the rate of 10 per cent. per annum, amounting to £1,462 10s., and a dividend of 4 per cent. per annum on the ordinary shares, amounting to £1,034 9s. 7d.; together, £2,496 19s. 7d. He would next ask them to turn to the report, and after making a few remarks regarding the pension fund for the employes, he formally moved the following resolution:—"That the report and accounts now presented be, and the same are hereby, received and adopted."

Mr. J. DENISON PENDER seconded the resolution, which was put to the meeting and carried unanimously.

The next resolution was moved by the CHAIRMAN as follows:—"That the dividend at the rate of 10 per cent. per annum, less income-tax, on the preference shares, and a dividend at the rate of 4 per cent. per annum, free of income-tax, on the ordinary shares, both for the half-year ended December 31st, 1892, be and they are hereby declared."

Mr. J. DENISON PENDER seconded, and it was carried unanimously.

Mr. JOHN GLOVER moved:—"That Mr. Edmund Etlinger and Mr. James Denison Pender be and they are hereby re-elected directors of the company."

This was also seconded and carried.

The auditor, Mr. Herbert R. Duke, was re-elected auditor to the company at a remuneration of 20 guineas.

A vote of thanks to the chairman and directors concluded the proceedings.

Arcas Plating Company.

THE first annual general meeting of the Arcas Plating Company, Limited, was held on Monday last week at Winchester House, Old Broad Street, E.C., Mr. E. Wolseley presiding.

The SECRETARY (Mr. John A. Coombe) having read the notice convening the meeting,

The CHAIRMAN said: Gentlemen, this is, as you know, the statutory meeting, and is only called in compliance with the Companies' Act, which requires that such meeting shall be held within four months of the incorporation of the company. I am afraid we have very little to report to you, as the meeting is of a purely formal character. We have had considerable difficulties to contend against. You know that this is a patent, and that it is our duty to protect you in every possible way—to see that that patent is perfectly good in every respect, and I am very happy to say that, after seeing counsel, and taking advice, all these details are now practically settled. We believe that we have got a most valuable patent, and we think that as soon as we extend our works, as we propose to do immediately, we shall be able to meet you, after a few months' time, with very satisfactory results. I might mention one thing—that the London Metallurgical Company, from whom we purchased this patent, have behaved in the most generous fashion to the Arcas Company. It was quite uncalled for, because we paid a large sum of money in shares for this patent—the English patent of the Arcas Plating; but they have given to us, without any charge of any sort, the American patent, and, as you are aware, in America, electro-plating is much more extensively used than it is in this country. We have got a place in the Chicago Exhibition, where we are about to exhibit, and I hope from that we shall be able to sell during the course of the year the American patent for a very considerable amount of money, which will be very satisfactory to all the members of this company. I am happy to tell you also that we have got the full working capital, and, as I said before, we have no hesitation in saying that you hold a very valuable patent on this side. I hope when we meet you in a few months' time we shall have the most satisfactory results to give you. I shall be very happy to answer any questions. You know that in the short period of three months—till the difficulties with the vendor company had been set at rest—it was impossible for us to show any practical results. If you would like to hear any of the details about the negotiations with regard to the patent, our solicitor is here, and will explain any of the difficulties there have been; but, as I told you before, they have been completely set at rest.

Major PHILIPS: Has the whole of the money been subscribed?

The CHAIRMAN: The whole of the £15,000 working capital.

Major PHILIPS: What is the number of shareholders?

The SECRETARY: About 80.

No further questions being asked, the proceedings terminated.

Chatham, Rochester and District Electric Lighting Company.

No dividends were declared at the annual general meeting of the Chatham, Rochester and District Electric Lighting Company, Limited, which was held on Tuesday last week, but it transpired that the share capital of £10,000 had been doubled within the year; the chairman, Mr. H. Jasper, having, in consequence of inability to raise the money otherwise, to undertake the carrying out of the contracts of the company, for which he has been allotted £8,315 in shares. This step has been necessary through Sir Courtenay Boyle, of the Board of Trade, threatening to withdraw the company's provisional order, because they continued to supply from the overhead mains. This critical condition of affairs was the subject of considerable discussion, the chairman refusing to divulge the terms of the contract, which, he said, might be inspected at Somerset House. Two directors, Dr. Weeks and Mr. F. Wingent, had retired from the board, and there appeared to be a general impression that a hard bargain had been driven, but it was explained that it had been impossible to obtain the money in any other way. The chairman stated that the money could not have been obtained otherwise, even for 50 per cent. interest, and that if it had not been immediately forthcoming the company would have collapsed; whilst Mr. M. H. Hurrell, M.I.C.E., stated that the contracts entered into with Mr. Jasper was for carrying out the underground mains, which was estimated to cost £6,000, the erection of a 200 H.P. engine, and to supply transformers equal to 50 per cent. more than the present output of the company. Mr. Hurrell has been appointed the managing director of the company, and since his appointment the works have been carried on at a profit, so that there is every prospect of a dividend being declared at the next meeting,

Eastern Extension, Australasia and China Telegraph Company, Limited.—The accounts of this company to December 31st last show, subject to audit, a balance of profit of £157,093 14s. 7d., after payment of three interim dividends. The directors now propose to distribute on the 19th prox. the usual dividend of 2s. 6d. per share, making a total dividend of 5 per cent. for the year 1892, together with a bonus of 4s. per share, or 2 per cent., making a total distribution of 7 per cent. for the year. The balance of £75,843 14s. 7d. has been carried to the reserve fund. The share register will be closed from April 12th to April 19th, both days inclusive.

Anglo-American Telegraph Company, Limited.—At a meeting of the board of directors of the Anglo-American Telegraph Company, Limited, held on 24th inst., it was resolved to declare an interim dividend for the quarter ending March 31st, 1893, of 12s. 6d. per cent. on the ordinary stock, and 25s. per cent. on the preferred stock, less income tax, payable on May 1st, to the stockholders registered on the books of the company on March 31st, 1893.

Eastern Telegraph Company, Limited.—Payment will be made on April 14th of interest of 3s. per share, less income-tax, being at the rate of 6 per cent. per annum on the preference shares for the quarter ending March 31st, and the usual interim dividend of 2s. 6d. per share on the ordinary shares, free of income-tax, in respect of profits for the quarter ending December 31st last.

Consolidated Telephone Construction and Maintenance Company.—At an extraordinary general meeting of this company held on Tuesday at Winchester House, Mr. C. L. W. Fitzgerald in the chair, the resolution passed at the meeting on the 9th inst. was confirmed, on the motion of the chairman, seconded by Sir Alexander Armstrong.

The Direct United States Cable Company, Limited.—The board have resolved upon the payment of an interim dividend of 3s. 6d. per share free of income tax, being at the rate of 3½ per cent. per annum, for the quarter ending March 31st, 1893, such dividend to be payable on and after April 24th next.

Globe Telegraph and Trust.—An interim dividend of 2s. 3d. per share has been declared by the board, payable on the 18th proximo.

The Anglo-Portuguese Telephone Company, Limited, announce a dividend at the rate of 5 per cent. per annum.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending March 26th, 1893, amounted to £859; week ending March 27th, 1892, £818; increase £41; total receipts for half-year, 1893, £11,270; corresponding period, 1892, £10,222; increase £1,048.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending March 24th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,348.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Issue.	Name.	Stock or Share.‡	Closing Quotation, March 23rd.	Closing Quotation March 29th.	Business done during week ended March 29th, 1893. Highest.	Lowest.
195,100*l*	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	101 — 104	101 —104	...	...
1,247,720*l*	Anglo-American Telegraph, Limited	Stock	52½ — 53½	53 — 54	...	...
2,876,140*l*	Do. do. 6 p. c. Preferred	Stock	92½ — 93½	93 — 94	94	92½
2,876,140*l*	Do. do. Deferred	Stock	13 — 13½	13 — 13½	13 3/16	...
130,000	Brazilian Submarine Telegraph, Limited	10	11⅜ — 12½	11½ — 12 xd	11⅜	...
34,600*l*	Do. do. 5 p. c. Bonds	100	100 —103	100 —103	...	...
75,000*l*	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	105 —109	105 —109	...	...
77,978	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	3 — 3½	3 — 3½	3 3/16	3½
75,000	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2½ — 2⅝	2½ — 2⅝	2⅝	2 5/16
125,000*l*	Do. do. 4½ per cent. Debenture Stock	Stock	103 —105	103 —105	105½	...
40,000	Chili Telephone, Limited, Nos. 1 to 40,000	5	3 — 4	3 — 4	...	...
630,000*l*	City and South London Railway	Stock	37 — 39	37 — 39	...	...
40,000	City of London Elec. Lighting Co., Ltd., Ord. 40,001-80,000 ...	10	12 — 12⅛	12 — 12⅛	12 1/16	...
20,000	Do. do. 6 p. c. Cum. Pref., Nos. 1 to 20,000	10	10½ — 10¾	10½ — 10¾	10 3/16	10 5/16
$7,716,000	Commercial Cable, Capital Stock	$100	178 — 182	178 —182	...	...
224,850	Consolidated Telephone Construction and Maintenance, Limited ...	14/-	¼ — ⅜	¼ — ⅜	...	...
20,000	Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos. 1 to 20,000	5	5¼ — 5⅜	5¼ — 5⅜	...	...
16,000	Cuba Telegraph, Limited	10	11½ — 12½	11½ — 12½	...	...
6,000	Do. do. 10 p. c. Preference	10	18 — 19	18 — 19	...	...
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	2½ — 3½	2½ — 3¼xd	...	...
6,000	Do. do. 10 p. c. Preference	5	9 — 10	9 — 10	...	...
60,710	Direct United States Cable, Limited, 1877	20	11⅝ — 11⅞	11⅝ — 11⅞xd	12	11⅞
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14⅞ — 15⅛	14⅞ — 15⅛	15⅛	14⅞
70,000	Do. 6 p. c. Preference	10	15⅝ — 16¼	15¼ — 16¼	16 3/16	16
200,000*l*	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	107 —110	107 —110	...	...
1,200,000*l*	Do. 4 p. c. Mortgage Debenture Stock	Stock	113 —116	113 —116	...	...
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	15¼ — 15½	15¼ — 15½	15½	15 5/16
70,600*l*	{ Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326 }	100	103 —106	103 —106	...	...
250,200*l*	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	103 —106	103 —106	...	...
320,000*l*	Do. 4 p. c. Debenture Stock	Stock	112 —115	112 —115	115⅞	113½
122,400*l*	{ Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343 }	100	102 —105	102 —105	103½	...
163,700*l*	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	102 —105	102 —105	...	...
300,000*l*	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	101 —104	101 —104	103¾	...
45,000	Electric Construction, Limited, Nos. 101 to 45,100	10	2⅞ - 3⅛	2½ - 3	2⅞	...
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ...	... ...	...	...
100,000	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	[illegible]	... ...	...	...
82,395	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	[illegible]	[illegible]	...	...
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd.	2	[illegible]	[illegible]	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	1½ — 2½	1½ — 2½	...	...
180,227	Globe Telegraph and Trust, Limited	10	9¾ — 10	9¾ — 10	10	9 13/16
180,042	Do. do. 6 p. c. Preference	10	15½ — 15⅝	15½ — 15⅝	15 7/16	15 5/16
150,000	Great Northern Tel. Company of Copenhagen	10	19½ — 19¾	19½ — 19¾	19½	...
210,000*l*	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	104 —107	104 —107	...	...
12,134*l*	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	4½ — 5½	4½ — 5½	...	...
9,600*l*	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	6½ — 7½	6½ — 7½	...	...
50,000	India-Rubber, Gutta Percha and Telegraph Works, Limited ..	10	22½ - 23½	22½ - 23½	23¾	22¾
200,000*l*	Do. do. 4½ p. c., Deb., 1896	100	104 —106	102 —104	...	...
17,000	Indo-European Telegraph, Limited	25	44 — 46	44 — 46	45½	...
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	2½ — 3½	2½ — 3½	...	...
11,334	Do. do. Preference Nos. 5,667 to 17,000 ...	10	6 — 7	6 — 7	...	...
30,000	†Liverpool Electric Supply, £3 10s. paid	5	4⅛ — 4⅜	4¼ — 4½	4¼	4 1/16
10,000	Do. do. fully paid	5	5 1/16 — 5 1/8	5⅛ — 6	5⅛	...
38,348	London Platino-Brazilian Telegraph, Limited	10	4 — 6	4 — 6	...	...
100,000*l*	Do. do. do. 6 p. c. Debentures	100	106 —109	106 —109	...	...
49,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	6 — 6½	6¼ — 7	6⅜	6⅛
50,000*l*	Do. 5 p.c. debentures, 1 to 5,000 in bonds of £10, £20, £40	...	102 —105	102 —105	...	...
454,747	National Telephone, Limited, Nos. 1. to 438,984	5	5¼ — 5⅜	5¼ — 5⅜	5⅜	5¼
15,000	Do. 6 p. c. Cum., 1st Preference	10	14⅜ — 15½	15 — 15½	...	...
15,000	Do. 6. p. c. Cum. 2nd Preference	10	14 — 14½	14¼ — 14⅜	...	...
90,950	Do. 5 p. c. Non-cum. 3rd Pref., Nos. 1 to 90,950 ...	5	5⅜ — 5⅝	5¼ — 5⅜	5 5/16	5¼
726,477*l*	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	113 —116	113 —116	114⅜	114¼
48,800*l*	New Telephone, Limited, Nos. 25,901 to 74,700 ... (£2 paid)	10	... ...	... ...	...	...
6,318	Notting Hill Electric Lighting Company, Limited, fully paid ...	10	5½ — 6½	5½ — 6½	...	...
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	⅛ — ¼	⅛ — ¼	...	...
11,802	Reuter's Limited	8	7 — 8	7 — 8	...	...
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	8¼ — 8⅜	8¼ — 8⅜	8 5/16	8¼
20,000	Do. do. 7 per cent. pref., Nos. 20,081 to 40,080	5	8 — 8½	8 — 8½	8 7/16	...
3,381	Submarine Cables Trust	Cert.	118 —123	118 —123	...	...
78,949	Swan United Electric Light, Limited ... ... (£3½ only paid)	5	3 — 3½	3 — 3½	...	...
37,350	Telegraph Construction and Maintenance, Limited	12	34 — 37 xd	34 — 37	34⅜	34½
150,000*l*	Do do. do. 5 p. c. Bonds, red. 1894	100	101 —104	101 —104	...	...
58,000	United River Plate Telephone, Limited	5	2½ — 3	2½ — 3	...	...
146,370*l*	Do. do. 5 p. c. Debenture Stock ...	Stock	90 — 100	90 —100	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	6½ — 7½	6½ — 7½	...	...
260,900*l*	Do. do. do. 5 p. c. Debentures	100	100 —103	100 —103	102	...
30,000	West Coast of America Telegraph, Limited	10	2½ — 3½	2½ — 3½	...	...
150,000*l*	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	105 —109	105 —109	...	...
64,242	Western and Brazilian Telegraph, Limited	15	7⅞ — 8¼	7⅞ — 8¼	...	...
33,129	Do. do. do. 5 p. c. Cum. Preferred	7½	5⅞ — 6¼	5⅞ — 6¼	...	...
33,129	Do. do. do. 5 p. c. Deferred	7½	2 — 2½	2 — 2½	...	...
184,100*l*	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	105 —108	105 —108	...	...
230,100*l*	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	105 —108	105 —108	...	...
88,321	West India and Panama Telegraph, Limited	10	1½ — 1⅝	1½ — 1⅝	...	...
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	11 — 11½	11½ — 11⅝	11⅝	11½
4,669	Do. do do. 6 p. c. 2nd Preference ...	10	9 — 10	9 — 10	...	...
80,000*l*	Do. do. 5 per cent debentures (1917) No. 1 to 1,000	100	107 —110	108 —111	109½	...
$1,336,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	120 —125	120 —125	...	...
171,000*l*	Do. do. 6 p. c. Sterling Bonds	100	101 —104	101 —104	...	...
59,900	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	5½ — 6	5½ — 6	5 13/16	5 11/16

* Subject to Founders' Shares. † Quotations on Liverpool Stock Exchange. Bank rate of discount, 2½ per cent. (January 26th, 1893).

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED:—Birmingham Electric Supply Company, Ordinary of £5, (fully paid) 5¼—6.—Brush Company 4½ per cent. Debenture stock, issued at 1 per cent. premium, 100 - 103.—Electric and General Investment, shares of £9 (£1 paid), 1½—2½.—Founders' shares, 200—225.—Electric Construction Corporation, 6 per cent. Debentures, 95—98.—Electricity Supply Corporation, Ordinary of £5, 5—5¼.—House to House Company (£5 paid) 1¼—2½.—Do. 7 per cent. Preference of £5, 5—5¼.—Do. 6 per cent. Debentures of £100, 97—102.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid), 5⅞—6⅛ xd, 1st Preference Cumulative 6 per cent., £5 (fully paid), 6—6½ xd.—Liverpool Electric Supply Shares of £5 (fully paid), 5⅛—5⅛ xd.—Manchester, Edison and Swan Company, £9 (£1 paid), ¼—⅜.—Queen Anne's Mansions Lighting and Heating, 6 per cent. £100 Debentures, 101—103.

‡ Unless otherwise stated all shares are fully paid.

THERMAL STORAGE FOR CENTRAL STATIONS.

PROF. FORBES brought the above subject before the recent National Electric Light Convention at St. Louis. Referring to the small period of maximum duty, he states that at the Kensington station, where the engines work at an economical load, the fuel used per electrical H.P. hour is 5 lbs., whereas on a 24 hours' run it is only 3½ lbs. Engines may always be arranged to work at an economical load by means of a suitable choice of dimensions and numbers, but boilers are not big enough to run for a few hours at full load on a small fire, and there is loss in cooling when the work is done.

Hence arises this call for thermal storage, which, in brief, consists of plain cylinders well protected against loss of heat by radiation, and partially filled with water, into which is to be fed steam from small boilers, which will be fired continuously, and, during 16 or 18 hours, will simply serve to raise the pressure and temperature of the stored water to about 400° F., and during the few hours of work steam will be taken off, presumably through reducing valves, at a lower and regular pressure, to the engines.

By such means a 10-horse-power boiler, working all day, would supply steam for 40 horse-power for six hours, and the loss of fuel would be reduced to that of a small furnace instead of a large one. The best practical point raised by Prof. Forbes was his reference to the possibility of precipitating the calcareous impurities of the feed water within the storage cylinders, and drawing always pure water into the boiler proper. All scale is thus deposited as sludge, and can be discharged at intervals as it accumulates, and being away from any of the baking action of fire, will never be a source of danger. The idea, which is credited to Mr. Halpin, resolves itself actually into a matter of a steam boiler of large capacity, with a very small furnace. The actual boiler must necessarily be exposed to the maximum pressure corresponding with the maximum temperature of 407°. This implies a pressure of 250 lbs., and with engines rated to work at 120 lbs., we get a range of temperature of 57° F. Provision clearly must be made for a furnace capable of working at 250 lbs. pressure. Assuming that the ratio of load time to idle time in the engines is 1 : 3, that is six hours of work per twenty-four, then, during the hours of work, one-fourth of the steam will be given by the little boiler, which is to be continually pegging away, and three-fourths is to be drawn from the storage tanks. Assuming a consumption per horse-power hour of 20 lbs. of steam, we shall require to draw 15 of these from the store. We are to obtain 50 units of heat from each pound of water in the store. One pound of steam contains, at 120 lbs. boiler pressure, about 867 units of so-called latent heat. It will absorb 867 units from the water. To produce 1 lb. of steam will thus necessitate the calling up of all the spare heat in 17⅓ lbs. of water. To supply a horse-power hour will therefore call for the exhaustion of 26 gallons of hot water per hour. From this we may see that to supply 100 horse-power for six hours will demand a store of 15,600 gallons. Assuming our store cylinder is one-third full of steam, we should require to supply ten cylinders, each 30 feet long and 4 feet diameter, or, what is the same thing, 2½ Lancashire boiler shells each 30 feet by 8 feet. The floor area thus covered comes to just about that occupied by the boilers and feed heater of a 60,000 spindle modern cotton factory. Thermal storage for 100 horse-power for six hours is as bulky as the steam generating plant for 1,000 horse-power, and must even then be helped out by the small boiler proper. So far as the figures are given, our results do not apparently differ from Mr. Halpin's, who would make 5 boilers do the work of 22, and use 92 storage cylinders of a size not given. One thing is evident; we must not imagine that thermal storage is going to help out the City station in the matter of space. For each 200 H.P. Willans engine we have 20 cylinders of 30 feet by 4 feet. Thermal storage may be dismissed for City purposes. We have always held that boilers should have a large water capacity, for this greatly promotes steady running, but, the maintenance of a fairly steady pressure during cleaning times—to meet a sudden call for more steam before the furnaces can respond, or to help the firemen over those crises which come to the best of firemen at times when the fires go wrong, are very different matters from providing three-fourths of your power out of the water. If content with an initial pressure of a little over 50 lbs. at the termination of a 6 hours' run of lighting, it would be possible to reduce the bulk of thermal cylinders by a half, and it is a question whether the saving due to an initial of 120 lbs. during one-half of the 6 hours' run will not be smaller than the loss by radiation from the double number of cylinders.

Prof. Forbes accepts Mr. Halpin's figures relative to the saving to be effected as compared with secondary batteries, and generally appears to make out a good case for thermal storage, *where space is not an object*, and there are some very excellent reasons for its adoption, some of which we have noted above, but where Prof. Forbes thinks it especially useful is in the utilisation of the heat of refuse incineration Here there should be scope for the system, for the fuel comes in almost as a gift. General refuse cannot well be burned under a steam boiler. It ought to be completely consumed in non-absorbent furnaces to render the process innocuous and inoffensive, and the heat utilised entirely outside the range of the place of combustion. Refuse destruction should be a continuous process, and the thermal storage system affords a means of saving heat which would otherwise be uselessly and wastefully dispersed. The pumping of water to a position of potential energy very rightly commends itself to Prof. Forbes as the best means of storage where there is a convenient hill, as, for example, at Edinburgh; but suitable reservoirs are not always to hand. A use for refuse, however, suggests itself in a place like London, where the water supply is chiefly pumped by day, and there is left for night time the production of light. The truth is, that the excessive individualism of all our undertakings is responsible for much waste. A pumping engine may not be suitable to drive dynamos, but the fuel which burns to waste in an incinerator would supply steam which would as well drive an electric engine as a pump, and the same set of boilers would supply steam for both purposes. We might, did we wish it, find means for dispensing with the necessity of thermal storage, but at present we prefer to ignore such clearly obvious advantages as are open to us by a line of less individual effort. But we must stop here, or hard names will be meted out to us.

In neglecting the steam stored in the 1,250 cubic feet of steam space which we assumed to be allowed in the storage cylinders, we have only made an error of about 2½ per cent. It is, perhaps, hardly fair to assume so high a ratio of steam space; allowing, therefore, that only one cylinder has steam space, the remainder being full of water, we shall require to use 7 storage tanks in place of each 10 as found under the conditions assumed. Between the limits of working pressure the power stored in steam is very insignificant, a cubic foot at 400° only yielding a quarter of a pound of steam in falling to the 350° limit. This may, therefore, be fairly left out of calculation.

Speaking generally, we should say that if anyone is disposed to be carried away by the thermal storage idea, they would do well to first make a few simple calculations as to the enormous bulkiness of the storage tanks, and not to forget the high temperatures which accompany high pressures when they come to consider the boiler proper.

THE ALTERNATING CURRENT SYSTEM IN AMERICA.

BY G. L. ADDENBROOKE.

AT the late St. Louis Convention, a paper entitled "Some Experiences with the Alternating System," was read by Mr. R. H. Sterling, and was followed by a long discussion.

In speaking of the paper, the President said: "Gentlemen, you have before you one of the most interesting papers that you are likely to have an opportunity to discuss, and I trust the discussion will be free and full."

As the paper is descriptive and non-controversive, and the discussion serves principally to elucidate it further, the two

together may be taken as fairly representative of the best present methods of operating alternating current stations in America, and the views of leading practical men upon the whole subject.

On the general question I do not think I can do better than extract almost *verbatim* a portion of the speech of Prof. E. R. Weston after the paper was read, as it is well worth the attention of English readers, and not only institutes a comparison between alternating and continuous currents, but between English and American practice. It is as follows:—

"The question of the distribution of energy by the two systems under discussion is receiving great attention both on this side and the other side of the Atlantic. At the present moment I do not think anyone is in a position to fully answer the question Mr. De Camp raises, namely, which is the more economical of the two systems? The systems as established here differ radically in one respect, at least, from the systems established on the other side. Here, for the purpose of economy in the first cost, a very high rate of alternation has been adopted. From present experience it seems as though this was a fundamental mistake, and that the mistake will be more apparent as the system has to be forced under ground, which it will sooner or later. We must all recognise the fact that any system of aerial conductors can never give us the safe and sure service which is necessary to enable us to compete with a satisfactory and reliable source of illumination such as gas. If our alternating current systems of this country were forced under ground, the loss would be, undoubtedly, greatly increased; but what the losses are exactly at present I have not been able to find out. No one seems to have made any special effort to determine them, and to ascertain exactly how they are distributed. With the direct system the losses are at the lowest point, and are very small, indeed, when the load is very light. The energy consumed then is practically what you use in the lamps; but in the alternating systems there is an increase of loss in the converters, as we readily understand. The difficulty of dealing with and ascertaining what these losses are through the wires is serious indeed, and it is impossible, almost, to arrive at them from the actual running plant, because it is very difficult to ascertain the total number of lights in circuit, and how these lights are distributed. To make a test, therefore, that would be really satisfactory, to ascertain the commercial efficiency of the alternating *versus* the direct current system, involves a great deal of labour and careful thought. The constant growth of the alternating current system indicates, however, one thing surely, namely, that it is filling a long felt want, and that it is a money-making investment, at least, for a large number of people. Whether the system as it exists in this country to-day will not be radically modified in the next few years, so as to approach more closely the systems of Europe, is a question; but I think it will. I think that will undoubtedly be done, and the tendency will be toward a lower rate of alternation and greater general efficiency. If any gentleman here has made a careful determination of the energy transformed, and has compared that with the energy actually used in the lamps, it ought to be brought out. It is a matter that everybody is seeking light on."

As no one seems to have taken any exception to these views, they may, being in accordance with the rest of the paper, be considered as agreeing well with the opinions of American engineers on the subject mentioned.

This speech shows, as, indeed, does the paper itself, that the greater part of American alternating work is still overhead, and that the methods of working adopted are designed to meet such a state of things.

Next, it points to the fact that there is even more uncertainty about alternating current measurements amongst practical men in America than on this side.

Lastly, it pays a very handsome tribute to English and European engineering in acknowledging that in theoretical and practical perfection the systems employed by us are the better, and are worthy of imitation, a tribute to the soundness of English engineering and science particularly, which is not ungrateful, although we on our side must acknowledge that Americans have made a more extended use of the alternating system than we have.

Another point worthy of notice is that neither in the paper or discussion is the parallel running of alternators mentioned as a usual practice, or a possible one; indeed, one speaker refers to the running of alternators on separate circuits as a direct advantage over the parallel method as adopted in direct current stations. That a question of such practical importance here, and which has received so much attention, should come in for so little on an occasion like this, may seem curious, unless the American present system of distribution is properly understood.

In England, with an underground service, it is of importance to have a few main circuits, and numerous branches leading from them, as it is undesirable to have many parallel but separate circuits in the same conduit or pipe. This objection does not, however, apply in America, where overhead circuits on poles are used. As the poles will carry a large number of wires or cables which are preferably light, it is easy to run a circuit direct from the station to any particular spot at any time without interfering with existing circuits. As further circuits are only erected for immediate prospective requirements, this method of distribution naturally brings it about that then a great many main circuits of comparatively small size starting from the station, consequently the load is easily distributed with fair economy over separate dynamos. The objections, however, to the galaxy of overhead cables or wires, which this system implies if worked on a large scale, is evidently, from the tone of the speakers at the convention, proving too much for even American susceptibilities, and therefore it is probable that it will not exist in large towns for many more years.

To work a system of this sort requires naturally an elaborate or rather extended switchboard, and Mr. Sterling devotes a good deal of his paper to a description of a typical one. In principle, it simply consists of what was known as the Edison switchboard in the early days of telephony. Mr. Sterling states that the board is preferably of marble. The circuits are all attached to vertical wires or cables arranged in pairs on the front of the board. On the back of the board are similar rows of wires, but running horizontally, a pair of wires for each dynamo. At the intersecting points double pole switches are placed so that any dynamo can be connected to any circuit. It is, of course, unnecessary to multiply this power of cross connection beyond a certain limit if the station is large, as the dynamos and circuits can be grouped in sections.

Directions are given for placing the volt and ampèremeters and fuses, but these do not differ essentially from English practice, and the remarks which follow, at some length, on fuses, are not of great moment, since English engineers have pretty well mastered the difficulties under this heading, working at 2,000 volts, whereas the standard American working pressure for the primary current is only half this. It may be said that horizontally placed fuses are found to act better and are less liable to arc than those placed vertically, a fact which we can thoroughly corroborate.

A long paragraph of Mr. Sterling's paper is devoted to lightning arresters, a subject which does not interest us so much on this side where circuits are underground, but the following on converter cut-outs and switches, is much to the point:—

"We are learning now that it is far preferable to have no fuses in the converter case, but a large primary fuse and switch box combined, removed from the converter." We have long since discarded secondary fuses in converters.

With the large number of circuits running parallel for long distances which the American system requires, it is not surprising to find that inductive effects occur occasionally between neighbouring wires when attached to different dynamos not working synchronously, and which results in the lights "jumping." The remedy adopted, if one of the circuits cannot be shifted on to another dynamo, appears to be to transpose the mains midway in the manner which is adopted in telephony.

The remainder of the paper and a considerable portion of the discussion are devoted to the question of maintaining the proper pressure at the lamps and to devices for effecting it. This is a subject which has not received the same attention in Europe as in America, partly because the American circuits are as a rule larger than ours and scattered over a wider area, but chiefly owing to the facts that the primary potential employed is usually only 1,000 volts in America instead of at least 2,000 as with us. These two circumstances, coupled with the use of numerous separate circuits,

has caused the regulating of the pressure in feeders to assume a more important and complicated aspect than it has here at present. Regarding this Mr. Wagner says in the discussion: "I suppose you refer to the average loss in distributing the current. Of course, that is left largely with the engineer designing the station and the circuits. In the case of the Missouri Electric Light Company it varies from 5 to 10 per cent.; the average probably is about 8 per cent.—6 per cent. in the feeders and 2 per cent. in the mains. It depends on the proportion between the average load and the maximum load. That differs at different seasons of the year."

Regulation is effected by means of the Stillwell regulator, or "booster," as it is euphemistically termed. This is simply a converter, each secondary turn of which is connected with a commutator. The secondary and the commutator are put in series with the main whose pressure it is desired to raise, and by altering the commutator more or less turns of the secondary can be included in the circuit. The primary circuit is simply connected across the mains in the ordinary way. The action of this apparatus is generally referred to as satisfactory, it being usually made to raise the potential by steps from 1 to 20 volts at will. As far as I am aware, similar apparatus is so far not in use in England because not yet needed, but as I believe its working is generally known to English engineers it is unnecesary to follow the description of it further, particularly as no theoretical details are given as to its working efficiency.

Such, as set forth in this paper and the discussion, appears to be the usual American method of distributing alternating currents to-day. It is characteristic that though questions are asked nothing is said to the point as to the relative efficiency of direct *versus* alternating currents, or how the efficiency of such an alternative station as is described works out. Our practical cousins seem still fairly satisfied with the fact that they can cover a large area of ground more easily and cheaply with an over-head alternating system, than with a low pressure direct one, and that it can be made to pay. As a general body they have evidently not yet reached the point we have, though as they get more circuits underground they will do so. If, therefore, any further solution of the question of alternating *versus* continuous current supply is to be looked for now it is to ourselves that we must turn for the solution.

COMPARATIVE TESTS OF HELLESEN AND E.C.C. DRY BATTERY CELLS.*

By Professor JAMIESON, M.Inst.C.E., F.R.S.E, &c.,
The Glasgow and West of Scotland Technical College.

Preliminary Remarks.

Advantages of Dry Cells.

It has been pointed out that dry cells possess certain practical advantages over wet batteries for bell calls, telegraphic, telephonic, medical, and military purposes. For laboratory work their unbreakableness, compactness, portability, cleanliness, and freedom from accumulating crystals, and the creeping of salts to the outside of the containing vessel, as well as the fact that they are always ready for use, and may be laid on their sides or even upside down, are evident advantages.

In the autumn of 1891 I happened to read an excerpt of a report on an exhaustive and carefully conducted series of tests by Messrs. Krehbiel, Narr, and Donle, of Munich, on six different kinds of "dry cells." † This report seemed to show that the "Hellesen" cell was the best.

I was, therefore, anxious to give the Hellesen dry cells a trial, and obtained at the beginning of last session (October, 1891) about forty of them from Messrs. Siemens Bros., of London, for use in the Electrical Engineering Laboratory of the Technical College. These cells have been employed since then by the students, principally for copper and insulation resistance and capacity tests, as well as for ringing bells. &c. They have unquestionably proved themselves to be much more convenient for such purposes than the previously used Daniell, Leclanche, Grove, Bunsen, and bichromate cells.

About this time last year I got a few E.C.C. dry cells from Mr. G. Binswanger, managing director of the General Electric Company, London, and, from their general behaviour in the laboratory, I formed the opinion that they were quite as good as those of the Hellesen type. In order, however, to make a set of comparative tests, I procured a couple of quite new Hellesen and E.C.C. cells of about the same weight, and again referred to the Munich report, from which I herewith give the following extract, in order to show that I was comparing the E.C.C. cell with a type of cell which had been proved to be the most efficient of six of the principal dry batteries.

Extract from the Munich Report.

"The most efficient cells, even for circuits of small external resistance, are the Hellesen and the Bender, the former having the advantage of less polarisation and much smaller internal resistance; the Hellesen cell has, however, when exhausted by long working, not quiet so much recuperative power as the Bender."

Total ampère-hours on closed circuit through an external resistance of 50 *ohms for* 96 *hours.*•

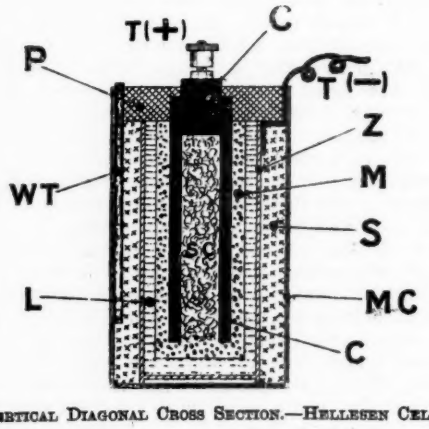
Hellesen...	2·3915	ampère-hours.
Bender	2·3400	" "
Thor	2·1435	" "
Gassner	1·9374	" "
Jenisch	1·0347	" "
Wolfschmidt	0·5967	" "

Total ampère-hours on closed circuit through an external resistance of 3 *ohms for* 24 *hours.*•

Hellesen	5·0792	ampère-hours.
Bender	4·9898	" "
Thor	3·4552	" "
Gassner...	2·6670	" "
Jenisch	1·2236	" "
Wolfschmidt	1·6168	" "

General Description and Chemical Constituents of the Hellesen and E.C.C. Dry Cells.

The following sectional drawings have been made by one of my laboratory students, Mr. D. Cameron, from sawn sections of the cells, and I am indebted to Dr. Henderson, Professor of Chemistry in the Technical College, for the chemical analysis.



Vertical Diagonal Cross Section.—Hellesen Cell.

Index to Parts.

T (+)	represents terminal positive.	Z	represents zinc containing vessel.
C	" carbon (bored hollow).	T (−)	" negative terminal wire.
S C	" silicate cotton.	S	" sawdust packing.
M	" manganese dioxide, &c.	P	" pitch (top covering).
L	" lime & sal-ammoniac, &c.	M C	" millboard case.
		W T	" waste tube.

Analysis of Black Paste (M).

MnO_2	= 25·54
Carbon	= 16·02
SiO_2	= 12·76
MgO	= 12·88
CaO	= 0·96
Fe_2O_3	= 3·46
Moisture and ingredients not determined	= 28·38
	100·00

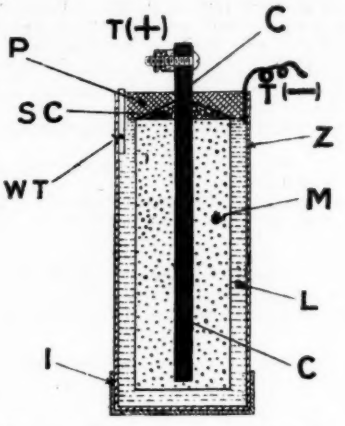
Analysis of White Paste (L).

CaO	= 26·18
ZnO	= 6·00
MgO	= 0·57
NH_3	= 2·49
Water and binding material	= 64·82
	100·00

* Read before the Philosophical Society, Glasgow, on March 22nd, 1893.

† The original report appeared in the *Elektrotechnische Zeitschrift*, of August 1st, 1890, Vol. ii., No. 31, and an extract in *The Electrician*, of February 6th, 1891, p. 419, Vol. xxvi.

• The cells were evidently of nearly equal size; the Hellesen being of the size No. 2, frequently referred to later on.



VERTICAL CROSS SECTION.—E.C.C. CELL.

Index to Parts.

T (+)	represents	terminal positive.	
C	„	carbon.	
S C	„	cotton.	
M	„	manganese dioxide, &c.	
L	„	lime and salammoniac, &c.	
Z	represents	zinc containing vessel.	
T (−)	„	negative terminal wire.	
P	„	pitch (top covering).	
I	„	insulating base.	
W T	„	waste tube.*	

Analysis of Black Paste (M).

MnO_2	=	7·57
Carbon	=	47·26
MgO	=	7·20
CaO	=	1·40
Fe_2O_3	=	2·12
NH_3	=	12·78
H_2O	=	9·77
Ingredients not determined	=	11·90
		100·00

Analysis of White Paste (L).

CaO	=	20·89
NH_3	=	20·29
Cl	=	6·31
Water and binding material	=	52·51
		100·00

FIRST SERIES OF TESTS OF THE HELLESEN AND E.C.C. DRY CELLS.

(Taken during April, 1892, by Messrs. D. A. Ramsay and J. F. Nielson.)

Table of Weights and Dimensions.

	Weight.	Dimensions.
No. 3 Hellesen	1·67 lbs.	5·5″ × 2·5″ × 2·5″
No. 2 E.C.C.	1·32 „	6″ × (2·5 diameter)

Initial and Final E.M.Fs. and Currents, with total ampère-hours.

(1). On closed circuit, through an external resistance of 5 ohms for 50 minutes:—

	E.M.F. in volts.		Current in ampères.		Output in ampère-hours.
	Initial.	Final.	Initial.	Final.	Total.
No. 3 Hellesen	1·430	1·255	0·230	0·222	0·183
No. 2 E.C.C.	1·455	1·287	0·248	0·229	0·197

(2). After 24 hours' rest, the E.M.Fs. of the same cells were taken, and they were again short-circuited through an external resistance of only 2 ohms for 50 minutes—readings being taken every five minutes, as in the previous case:—

	E.M.F. in volts.		Current in ampères.		Output in ampère-hours.
	Initial.	Final.	Initial.	Final.	Total.
No. 3 Hellesen	1·355	1·126	0·446	0·389	0·322
No. 2 E.C.C.	1·393	1·079	0·509	0·434	0·388

E.M.F. after being short-circuited.

(3). After another rest of 24 hours, the same two cells were short-circuited by joining their terminals directly together. Observations of their E.M.Fs. were then made after 15 minutes; again short-circuited for other 15 minutes, and similar readings taken; and, finally, short-circuited for 23 hours, and the E.M.F. recorded.

The following table gives the results obtained:—

Cell.	Electromotive force in volts.		
	After 15 minutes.	After 30 minutes.	After 23·5 hours.
No. 3 Hellesen ...	0·966	0·928	0·167
No. 2 E.C.C. ...	1·104	1·054	0·597

Current and ampère-hours observed whilst short-circuited.

(4). A new pair of cells of the same size as before—namely, a No. 3 Hellesen and No. 2 E.C.C.—were short-circuited through the very small external resistance of the thick copper wire of a Helmholtz tangent galvanometer. Current readings were taken by this instrument every 3 minutes for a period of 54 minutes:—

Cell.	Current in ampères.		Ampère-hours.
	Initial.	Final.	Total.
No. 3 Hellesen ...	2·07	0·8	0·95
No. 2 E.C.C. ...	4·7	1·75	2·18

In this first series of tests, over 200 observations were made, not only for E.M.F. current and internal resistance, but also to ascertain their efficiency as accumulators. We have, however, so many other results of a similar kind to lay before you in describing the second and the third series of tests, that we think it advisable not to overload this paper with them.

SECOND SERIES OF TESTS OF THE HELLESEN AND E.C.C. DRY CELLS.

(Taken during November and December, 1892, by Messrs. F. Carleton Anderson, J. Bisset George, and W. B. Wilson.)

The new cells placed at my disposal were measured and weighed, as recorded in the following table:—

Table of Cells as Paired for Approximate Weights.

Excess of weight shown in last two columns.

E.C.C. No.	E.C.C. External Dimensions.	E.C.C. Weight.	Hellesen. No.	Hellesen. External Dimensions.	Hellesen. Weight.	Excess. E.C.C.	Excess. Hellesen.
		lbs.			lbs.	lbs.	lbs.
1.	7″ × (3″ diameter)	3·36	1.	7″ × 4″ × 4″	5·56	...	2·2
0.	4·75″ × 4·5″ × 2″	3·11	2.	6·5″ × 3″ × 3″ ...	2·89	·22	...
2.	6″ × (2·5″ diameter)	1·92	3.	5·5″ × 2·5″ × 2·5″ ...	1·67	·25	...
3.	5″ × (2″ diameter)	1·11	4	5·375″ × 2·25″ × 2·25″	1·43	...	·32
4.	3·875″ × 1·5″ × 1·5″	0·656	6.	3·75″ × 1·5″ × 1·5″ ...	0·51	·146	...

Current and Potential Difference.

The following method was devised to enable tests to be made with *one* galvanometer for measuring both the current and the potential difference:—*

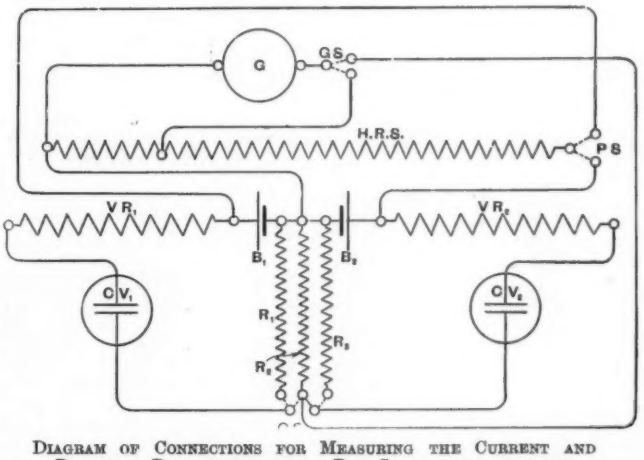


DIAGRAM OF CONNECTIONS FOR MEASURING THE CURRENT AND POTENTIAL DIFFERENCE OF THE DRY CELLS USING ONLY ONE GALVANOMETER.

* This short glass tube should have been drawn with its lower end terminating in the cotton at S C. These tubes in both cells are evidently to carry off any waste gas.

* In the first series of tests, the electromotive force (E.M.F.) was observed. In the second and third series of tests, not only the E.M.F. (in certain cases), but also the potential difference (P.D.) or electrical pressure between the terminals, was taken. We distinguish between the E.M.F. and the P.D. in the following manner. The E.M.F. is the *total* electrical pressure generated *inside* the cell. The P.D. is the electrical pressure between the terminals of the cell, and is always less than the E.M.F. by the amount constituting the fall of pressure within the cell necessary to maintain the current flowing through the cell at the time of observation.

Or E.M.F. = P.D. + $c_c \times r_c$. Where c_c is the current flowing through the cell and r_c is the resistance of the cell. If $c_c = 0$, then the P.D. = the E.M.F.

Index to Parts.

B_1, B_2 represent the 2 cells to be compared.	C S represents current switch.
V R_1, V R_2 represent the 2 variable resistances.	H R S „ high resistance shunt
C V_1, C V_2 represent the 2 copper voltameters.	G „ galvanometer.
R_1, R_2, R_3 represent the resistances.	G S „ galvanometer switch
	P S „ potential switch.

When measuring the potential difference, the galvanometer was connected across a part of the high resistance shunt, H R S. This resistance could be joined up between the poles of either cell by simply turning the potential switch, P S, as shown in the diagram. The two resistances, R_1 and R_3, were each made as nearly as possible equal to R_2. The current to be determined was passed through the resistance, R_2, and the potential difference at its extremities measured by the galvanometer, G.

Before each test the galvanometer scale was carefully calibrated for measuring the potential by means of a Dr. Fleming's standard cell (E.M.F. = 1·072 volts, according to the latest Board of Trade standard). The values of the scale readings for the current measurements were determined from the weight of the copper deposited in the copper voltameters, C V_1 and C V_2.

Potential Current (Test No. 1.)

The following series of observations was commenced with new cells, No. 1 E.C.C. and No. 2 Hellesen. Both cells were allowed to discharge at a certain current strength, as adjusted by V R_1 and V R_2, for about for four minutes, before the potential difference was taken, thus giving the cells time to polarise. The initial and final results are given in the following table, and the whole of the observations are plotted in the potential current curves (No. 1):—

Cell.	Potential difference in volts.	
	Initial.	Final.
No. 2 Hellesen	1·43	1·103
No. 1 E.C.C.	1·34	1·118

E.C.C. started at 1·255 volts, while the Hellesen started at 1·285 volts, and after 2 hours 55 minutes the E.C.C. gave 1·175 volts, and the Hellesen 1·110 volts; thus showing that the E.C.C. kept up its voltage better than the other cell under the same working conditions.

Cell.	Potential difference in volts.	
	Initial.	Final.
No. 2 Hellesen	1·285	1·11
No. 1 E.C.C.	1·255	1·175

Potential Time (Test No. 3.)

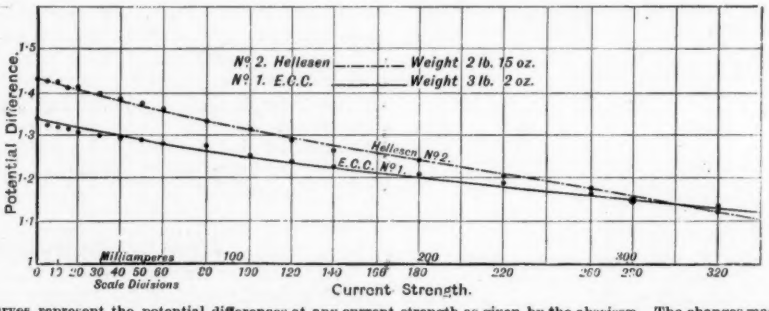
After a rest of about 20 hours, the same cells were again tested for 2 hours 35 minutes, to ascertain the recuperative effect due to rest.

Cell.	Potential difference in volts.	
	Initial.	Final.
No. 2 Hellesen	1·22	1·09
No. 1 E.C.C.	1·21	1·17

Potential Time (Test No. 4.)

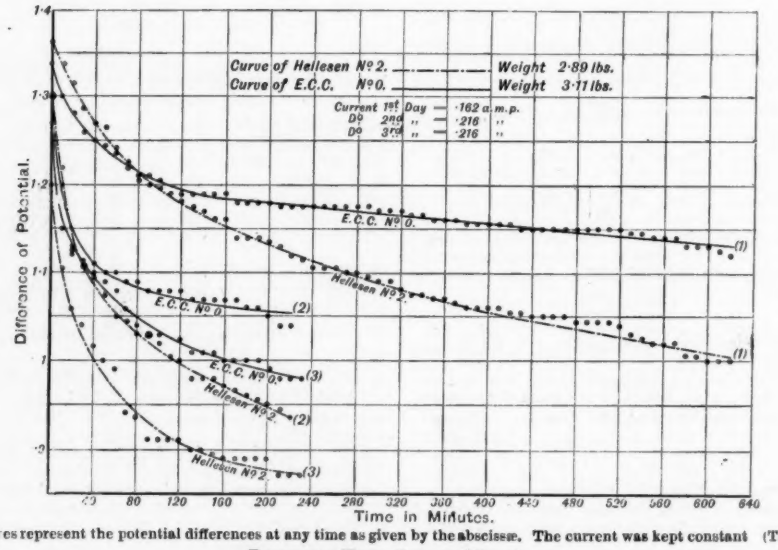
New cells (No. 2) Hellesen and (No. 0) E.C.C. were now tried with a constant current of 0·162 ampére. The current was regulated as before by the variable resistances V R_1 and V R_2. The test was started at 9·45 a.m., and continued for 12 hours without stopping. The results are plotted in the accompanying curves (1) and (1). The Hellesen cell deposited during these 12 hours 2·561 grammes, and the E.C.C. in the same time 2·517.

These same two cells were again tested for a period of three hours 40 minutes. The results are plotted in curves (2), (2). Finally they were tested for 3 hours 50 minutes, and the results are shown by the curves (3) and (3). The current in the latter two cases being 0·216 ampére.



The ordinates of these curves represent the potential differences at any current strength as given by the abscissæ. The changes made in the current were "step down." The potential difference was observed in each case after the current had remained steady for 4 minutes. (Tests taken December, 1892.

POTENTIAL-CURRENT CURVES (No. 1).


Curve of Hellesen Nº 2. ..... Weight 2·89 lbs.
Curve of E.C.C. Nº 0. ..... Weight 3·11 lbs.
Current 1st Day — ·162 a.m.p.
Do 2nd Do — ·216 „
Do 3rd Do — ·216 „
E.C.C. Nº 0.
Hellesen Nº 2.
Difference of Potential.
Time in Minutes.

The ordinates of these curves represent the potential differences at any time as given by the abscissæ. The current was kept constant (Tests taken December, 189

POTENTIAL-TIME CURVES (No. 4).

Potential Time (Test No. 2).

In this case the same cells as in (*Test No.* 1) were used. The current was kept constant by varying the resistances, V R_1 and V R_2, and the potential difference was measured every *ten* minutes. The

THIRD SERIES OF TESTS OF THE HELLESEN AND E.C.C. DRY CELLS. (Taken by Messrs. J. Fred. Nielson and Forbes W. Bruce.)

The students having gained more experience in the taking of such tests, my assistant, Mr. Andrew Gray, arranged for the follow-

ing more complete scheme of observations, in order to determine:—

Firstly.—The *fall of potential* while on closed circuit and maintaining approximately the *same current* throughout the whole of the test.

Secondly.—The *variation of the potential difference* at the terminals of each cell *due to the variation of the current strength* in its external circuit.

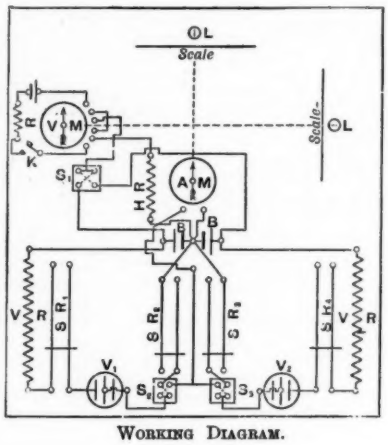
Thirdly.—The *apparent internal resistance* of each cell at *different current strengths.*

Fourthly.—The *recuperativity* and the *time-rate of the rise of electromotive force* after being short-circuited until as nearly as possible exhausted.

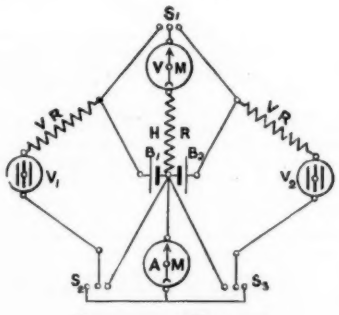
Fifthly.—The *total available external energy* (or number of watt-hours expended in the external circuit of each cell, discharging through a constant resistance until practically exhausted); also the *total number of ampère-hours* obtained from each cell.

Sixthly.—The percentage *reduction of the electromotive force due to polarisation.*

In these tests, cells of as nearly as possible equal dimensions were paired against each other, as shown by the previous table of weights and their dimensions.



WORKING DIAGRAM.



THEORETICAL DIAGRAM.

Index to Parts.

B represents	battery.	V R represents	variable resistance.
V M "	voltmeter.	S R "	sliding resistance.
A M "	ammeter.	S "	switches.
V_1, V_2 "	voltameters.	K "	key.
H R "	high resistance.	L "	lamps.

REARRANGEMENT OF APPARATUS FOR TESTING HELLESEN AND E.C.C. DRY CELLS.

The method employed was that of using two galvanometers—one of high resistance to measure the potential difference, and the other of low resistance to measure the current strength.

In those tests in which a constant current strength was maintained throughout, a voltameter (see figs. 1 and 2) was included in each circuit, so that the current could be accurately measured by the weight of copper deposited. Resistance boxes, together with slide resistances, were employed to vary the resistance in the circuit. Each cell was joined up with its own separate circuit, and the apparatus was so arranged that the potential difference at the battery terminals and the current flowing in each circuit could be measured by merely, switching each cell in turn on to the voltmeter (V M) and the ammeter (A M).

The high resistance astatic mirror galvanometer of 45,000 ohms, which was used as the voltmeter, had in circuit with it a resistance of 100,000 ohms, so that the total resistance amounted to about 145,000 ohms, and was so controlled that the deflection produced by Dr. Fleming's standard cell (E.M.F. = 1·072 volts), was 536 divisions. Thus, the value of a scale division was 0·002 volt, and to obtain the value in volts of any potential difference, the deflection had only to be multiplied by that number.

The low resistance mirror galvanometer was under strong magnetic control and shunted by a short wire, and was calibrated to read in *milliampères* by the ordinary copper deposition method.

Paraffin blocks, with mercury cups, were used as switches, and the connections were made by inserting stout copper wire cross-pieces. The working arrangement of the apparatus and the theoretical diagram are clearly shown in the drawings.

(*To be continued.*)

LEGAL.

TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY, LIMITED, *v.* WESTERN BRAZILIAN TELEGRAPH COMPANY.

Mr. JUSTICE BARNES sitting in the Court of Admiralty on Thursday in last week, heard an action for salvage services brought by the Telegraph Construction and Maintenance Company, Limited, as owners of the steamer *Scotia*, with her master and crew, against the Western Brazilian Telegraph Company, as owners of the ss. *Norseman*. The Construction and Maintenance Company having contracted to lay a cable for the Western Brazilian Company from Santos to Chuy on the east coast of South America, engaged the *Scotia* in the work, the *Norseman* being called in to assist by laying the shore ends. The *Scotia* was of 2,931 tons net and 4,656 tons gross, her value being £120,000, and she had on board, besides a crew of 105 hands and 16 cable hands, a cable worth £4,100, and cable stores of the value of £3,680. The *Norseman*, which was 827 tons net and 1,368 gross, had a cable on board valued at £7,590, and cable stores of the value of £2,000. On the night of May 11th last they both anchored in Chuy Bay, and about 4 in the morning the *Norseman* was seen to be flying distress flags and the signal "I am sinking." The *Scotia* making for her, found that she had sprung a leak and had 11 feet of water in her engine room and 5 feet in her hold. The next day the master and officers of the *Norseman* boarded the *Scotia*, and was so satisfied that she was sinking, that they brought away from her the piano and other effects. Through May 14th, 15th and 16th the *Scotia* towed the *Norseman* to Monte Video, and her case was, that but for this assistance the *Norseman* would probably have foundered. His lordship awarded £3,000, apportioning £2,250 to the owners, £200 to the master, £180 to nine of the crew; and to the remainder of the crew, except the cable men, £370.

NEW PATENTS—1893.

5,355. "Improved means for rendering the sparking of commutators, switches, fuses, and the like, harmless in explosive atmospheres." G. ROLF and W. C. MOUNTAIN. Dated March 13th.

5,406. "Improvements in electric railway signalling." F. P. SCHLOSSER. Dated March 13th.

5,419. "A new or improved manufacture of electric switches." H. H. CASS. Dated March 13th.

5,470. "Railway electric fog signals." H. SIBERY. Dated March 14th.

5,486. "Improvements in commutators for dynamo-electric machines, and method of constructing the same." A. W. MESTON. Dated March 14th. (*Complete.*)

5,495. "Improvements in or relating to the electro-deposition of metals." W. P. THOMPSON. (Communicated by F. L. Pope, United States.) Dated March 14th.

5,505. "Improvements in apparatus for moulding the bodies of electric switches, bell pushes, ceiling roses, and other like articles, in china and earthenware." H. WATKIN. Dated March 14th.

5,525. "Improvements in electrolytic apparatus for decomposing chloride of sodium or potassium in solution, and for leading away the products of decomposition." T. J. HOLLAND. Dated March 14th.

5,580. "McLachlan's electric stern attachment for the propulsion of rowing boats, &c." E. A. MCLACHLAN. Dated March 15th.

5,638. "Multiple change-over mechanism for electric arc lamps." W. J. DAVY. Dated March 16th.

5,639. "Multiple telegraphy." J. MCCRAITH. Dated March 16th.

5,652. "Improvements in switches in connection with electricity." J. R. KAY. Dated March 16th.

5,655. "Improvements in electric arc lamps." C. RICHARDSON and E. G. HERBERT. Dated March 16th.

5,684. "Improvements in portable electric primary batteries, and in their application to miners' and like portable lamps." M. P. TUCKERMAN and A. D. MACKENZIE. Dated March 16th.

5,694. "Improvements in apparatus for the electrolytic decomposition of solutions of chloride of sodium and potassium." J. C. RICHARDSON. Dated March 16th.

5,698. "A method for lighting by electricity all descriptions of wheeled vehicles." S. ROBSON. Dated March 16th.

5,701. "Improvements relating to the coating of articles with metallic alloys by electro-deposition." S. O. COWPER-COLES. Dated March 16th.

5,709. "Improvements in the cores of armatures for dynamos, magneto machines, motors and other purposes." H. F. JOEL. Dated March 16th. (*Complete.*)

5,715. "A new and improved depolariser for galvanic batteries." O. FERGUSSON. Dated March 17th.

5,720. "Moseley's simplex burglar and thief-proof electric alarm." G. MOSELEY. Dated March 17th.

5,771. "Improvements in apparatus for electrical lighting." P. SCHARF. Dated March 17th. (*Complete.*)

5,778. "An improved process of manufacturing bleaching solutions by electrolysis." A. J. BOULT. (Communicated by O. Knœfler and F. Gebauer, Germany.) Dated March 17th. (*Complete.*)

5,782. "Improvements in telegraph poles." T. G. MARSH. Dated March 17th.

5,844. "Improvements in storage batteries." W. P. THOMPSON. (Communicated by M. Hartung, Germany.) Dated March 18th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1891.

The Price of all Specifications (old and new) is now 8d. each.

11,538. "Improvements in non-continuous conductors for electric propulsion or traction on permanent way." G. PROKOFIEW. Dated July 7th. The inventor takes pieces of iron rails (not steel ones) of 1 metre (39⅜ in.) in length; to each piece underneath, and also in the middle of its length, he attaches a small box of glass well isolated; the box contains a small piece of iron, while a well polished piece of cable, ending with a flat piece of brass isolated from the rail, comes into the box. These pieces of rails are put along the whole line required, at a distance of 2·7 metres from each other, while each box is communicated to the cable running along the line. To the car two electro-magnets are attached, and pass so close to the above-mentioned rails as only not to rub them. All the four poles of these electro-magnets are in one line along the car, so that two equal poles are within, and two at the ends. When one of these poles comes over a piece of rail, it develops along the entire length of the piece only one pole; then the piece of iron in the box is attracted, comes in contact with the brass piece of the small cable, and with the piece attached to the rail. By this contact it conducts the current from the cable (coming, of course, from the central station dynamo machine) to the rail, and from the brushes to the car motor. But when the magnet comes to a position so that both of its poles influence the rail, and therefore develop two poles on the end of the rail, then the piece of iron which conducts the current from the cable to the rail falls in virtue of its being in a neutral position, thus separating the car from the cable. 8 claims.

12,019. "Improvements in the manufacture of carbons for electric arc lamps." W. L. WISE. (A communication from the Rheinische Fabrik für Elektrische Bogenlichtkohle: W. Grüdelbach, of Germany.) Dated July 15th. Hollow rods, that is to say, rods formed with a core hole, are made by pressing, and are then baked, after which the substance employed for the core is charged into the core hole. 1 claim.

12,150. "Improvements in magneto-electric timepieces." W. R MAY. Dated July 17th. The pendulum of the timepiece is driven by the means of an electro-magnet or electro-magnets, which may be furnished with one or more coils. To the pendulum is attached a piece of iron of a convenient section which forms the armature to the electro-magnet or electro-magnets. In this piece of iron a recess is made, in which recess a small piece of metal, which is preferably wedge-shaped, is pivoted. Alongside the electro-magnet or electro-magnets, and between the pole or poles thereof, two vertical or horizontal rods or pieces of metal, which may be either flexible or rigid, are fixed at a convenient distance apart from each other. According as the swinging movement of the pendulum slackens the small piece of metal on the armature drops between, or on to these two contact rods or pieces, and brings the magnet or magnets into operation, so imparting fresh impetus to the pendulum, and causing it to give a longer swing. During the interval between each contact, until the swinging of the pendulum is at the minimum, the small piece of metal, by reason of its being pivoted, will pass over the contact rods or pieces without making contact with them. 2 claims.

13,362. "Improvements in dynamo-electric machines." G. FORBES. Dated August 7th. Consists in carrying the current along fixed conductors between the magnet poles and the armature, or let into the polar faces, so that the action of the current in these conductors, in distorting the field, is equal in magnitude and opposite in direction to the distorting action of the current in the armature. 2 claims.

14,097. "Improvements in telephone transmitters and the methods adopted for the transmission of articulate speech, musical and other sound waves." H. L. TODD and J. TODD. Dated August 20th. Consists of a diaphragm attached by its centre to a flexible attachment secured or fixed to the transmitter case in such form or manner as to allow of easy vibrations of the diaphragm in order to produce the proper transmission of articulate speech without the aid of additional parts for adjustment. 6 claims.

14,236. "An improved method of arranging apparatus for generating and distributing electricity by alternating currents. H. R. Low and G. E. B. PRITCHETT. Dated August 22nd. Consists of a combination of the following apparatus:—1. Accumulators or storage batteries. 2. A direct current electro-motor, which is also used as a dynamo coupled to an alternating current generator (for convenience we will call this combination the motor alternator). 3. A steam engine, or other source of power (which we will term the prime motor), arranged by means of any suitable gearing, such as a friction clutch or loose pullies, so that it may be connected to, or disconnected from, the motor alternator, whilst either is in motion. 2 claims.

14,266. "Improvements in appliances for the administration of electricity to horses for curative purposes." M. HUMM and A. E. HUMM. Dated August 24th. Relates to leg baths made in the form of a boot, bands, pads, knee caps or similar devices for administering electricity to horses for curative purposes; and to electrodes to be used in such devices or appliances, and consists in making the said appliances, or a part or parts of the same, of leather or canvas on the outside, and rubber covered cloth or other suitable insulating material on the inside, to which are fastened metal plates joined together by conducting cords or metal wires, in such a manner as to allow one set of metals to be attached to the positive pole of a battery or induction coil as may be required, and the other set of metals to be attached to the negative pole of the battery or induction coil. 3 claims.

14,508. "An improved 'arc' lamp." J. S. WARBURTON. Dated August 27th. Claims:—1. The combination with a brake lever of an "arc" lamp of a pulley or pulleys, substantially as and for the purposes shown and described. 2. The combination of a tilting weight and a tilting lever and a replacing arm, with and actuated mechanically by one or other of the "cores," or a weight or other part of the controlling mechanism of the lamp, substantially as and for the purposes shown and described.

15,483. "Improvements in electric lighting and in the means therefor." J. C. MEWBURN. (Communicated from abroad by P. Sée, of Lille.) Dated September 12th. Consists in placing the luminous point in an inverted reflector, thus lighting the ceiling or roof which in its turn reflects the light to all parts of the place to be lighted. 5 claims.

15,579. "An improved arrangement of automatic electric switch and cut-out for use in charging secondary cells, and for similar purposes." O. MARCH. Dated September 14th. The apparatus consists of two or more solenoids preferably inverted. In the case of two solenoids only being used, one is wound with wire of a capacity suitable for carrying the main current, and is termed the series coil, the other is wound with fine wire having a sufficient resistance to enable it to be placed in shunt across the dynamo terminals, and is termed the shunt coil. Each solenoid operates upon a suitable core attached to a rocking arm; such rocking arms carry suitable bridge pieces for making the necessary contacts, on dipping into suitable mercury cups. 1 claim.

15,697. "Improvements in electric telephonic transmitters." J. GRAHAM. Dated September 16th. In a suitably constructed case, say a one similar to an ordinary "watch receiver" case, the inventor bores two holes through from the inside of the case, which pass out at the back. One of these holes passes through the bottom of the recess intended to hold one of the electrodes and the granulated carbon, and the other passes through an abutment or shoulder, intended for the support of the other electrode or diaphragm. Into the said holes, at the back of the case, he screws or otherwise affixes two terminals; and into the other ends, inside of the case, he places two spiral springs, which fit them just sufficiently to allow of free and parallel action, and to project two or three twists above the edge of the holes. Against the bottom of the recess he affixes one of the electrodes which presses upon the end of one of the spiral springs, and is thereby brought into metallic connection with one of the terminals at the back of the case. 4 claims.

17,426. "An improved mode of and apparatus for generating ozone by electricity." E. ANDREOLI. Dated October 13th. Claims:—1. The production of ozone in large quantities by means of silent discharges in chambers, through which atmospheric air or oxygen is caused to circulate, the opposed point-bearing metallic plates, or their equivalent, representing the opposite poles of an induction coil or other convenient generator of electricity. 2. The use, in an ozonising apparatus, of a pair or pairs of plain and pinned, or point-bearing, terminal plates.

1892.

2,544. "Improvements in electrical motors." A. J. BOULT. (Communicated by W. J. Still, of Toronto.) Dated February 9th. The object of the invention is to construct the motor that any delay in the demagnetising of the magnet after it has performed its duty shall not detain or check the revolving of the shaft, and it consists essentially in journalling the armatures upon the driving shaft and connecting it thereto by means of a disc fixed to the shaft, having pins projecting from it in front of each armature, a spring or springs being arranged to hold the armature against its pin in such a manner that should the demagnetising of the magnet be momentarily delayed, the detaining of its armature will not check the revolving of the shaft on which the armature is journalled. 4 claims.

3,970. "Improvements in dynamo-electric machines." B. J. B. MILLS. (A communication from R. Lundell, of New York.) Dated March 1st. Relates to the construction and arrangement of several parts of dynamos or electric motors, and especially to the construction of the field magnets, and the arrangement of the magnetising coils for said field magnets. 4 claims.